WATER & SEWAGE WORKS

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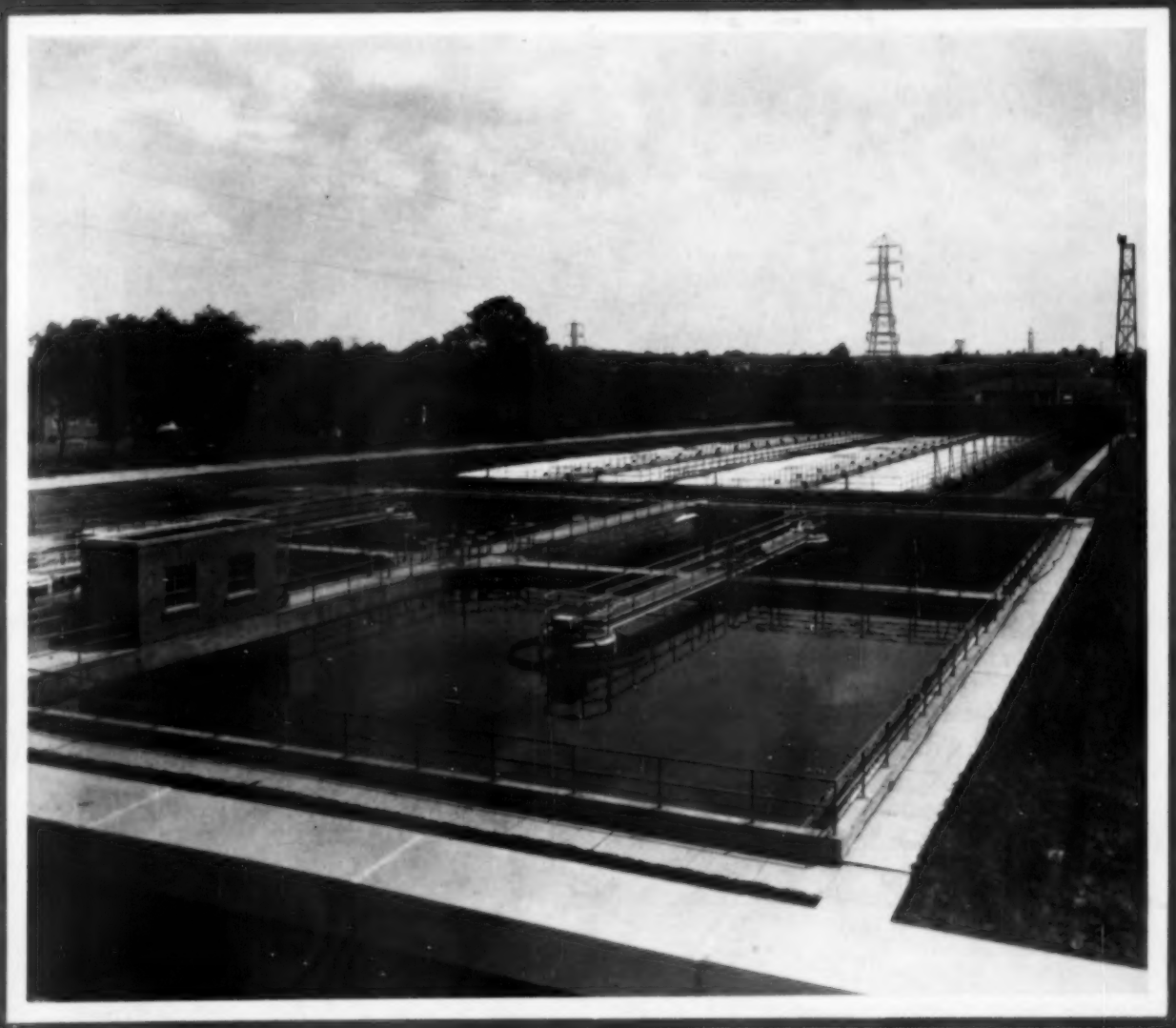
WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL



Dual Disposal Plant at Canton, Ohio—See page 176

Cleaning and Lining Water Mains

Survey: Vacuum Filtration Disposal of Sewage Sludge

APRIL 1955

VALVE OPENING *equals* PIPE OPENING

4" valve port area—12.75 sq. in.

4" pipe area—12.73 sq. in.

That's the formula of success behind **acf** Rectangular Port Valves! Because they have a port area at least equal to the pipe itself... turbulence and loss of head pressure are held to a minimum... even when handling heavy slurries and other viscous ladings.

All **acf** *Cylindrical* Lubricated Plug Valves... both those with rectangular and round port openings ...feature split-second, quarter-turn shut off that meets the rigid control requirements in the petroleum, natural gas, and processing industries. Maintenance is especially low because they are fitted with TEFLON* gaskets to prevent head leakage, and have no line seats exposed to fluid flow.

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Representatives in 50 Principal Cities. Write for Descriptive Catalog 5-WS **acf** Industries, Incorporated, Valve Division, 1501 E. Ferry Avenue, Detroit 11, Mich.

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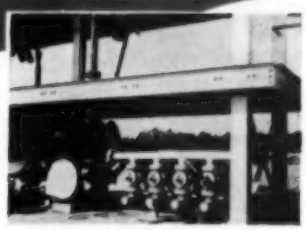

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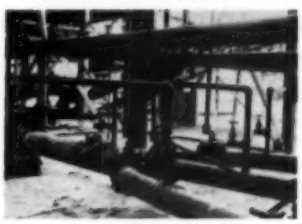
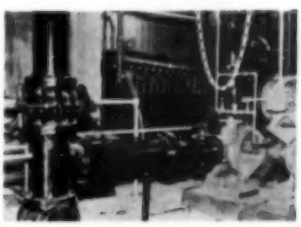


In Chemical Plants



In Sewage Treatment

acf CYLINDRICAL FULL PIPE AREA PLUG VALVES

This Clay Pipe Sewer in Texas City was designed by Joe J. Rady & Co., consulting engineers, who also supervised the installation. The line runs along Galveston Bay. At some points it had to be laid in quicksand six feet below sea level.

323 MILES of CLAY PIPE

Provide Modern Sewerage for Galveston County, Texas

More than 1,700,000 feet of Clay Pipe have been installed in Galveston County in the past 18 years to meet the needs of expanding industry and a growing population. When Joe J. Rady & Co. first began work in Galveston in 1937, only two cities in the county had sewerage systems. Today, Clay Pipe sewerage systems have been installed in every community of 1,000 population or more. Referring to infiltration, which has always been a big problem in this area, Mr. Rady says: "This naturally dictated the *exclusive use of Vitrified Clay Pipe,* which has been specified on each and every sewerage collection system."

Next time you specify, buy, or install sewer pipe, remember this fact: engineers who handle the big, long-range projects specify and recommend Vitrified Clay Pipe. *It's guaranteed for 50 years. It never wears out.*

CLAY PIPE FITTINGS are available to help solve every installation problem. This Cut Curve, for example, is available in sizes through 36".

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CLAY PIPE

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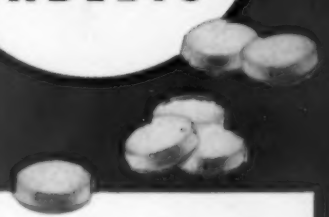
CONTROLLED CHLORINATION

to disinfect new mains

use slow-dissolving

HTH TABLETS



For economical, effective disinfection of new water mains and extensions, a new procedure using HTH Tablets has been developed that eliminates the principal objections to other methods. Pioneered by J. R. Rossum, sanitary engineer, California Water Service Co., San Jose, Calif., this method has been employed on several hundred jobs with exceptional results.

HTH Tablets are fastened to the interior top of the pipe with hot tar or a suitable gasket cement. When the pipe is filled, density currents generated by the solution of the chemical carry the hypochlorite solution a distance of several pipe lengths. Since the HTH Tablets remain in place and dissolve slowly, the disinfectant is not washed to the far end as the main is filled. The table shows how to obtain a minimum chlorine dose of 30 ppm.

Length of Section	Diameter of Pipe Line or Main 2"	4"	6"	8"	10"	12"
13'	*1	1	1	2	3	3
18'	1	1	2	2	3	5
20'	1	1	2	3	4	5
30'	1	1	2	4	5	7
40'	1	2	3	5	7	10

*Recommended number of HTH Tablets to be used per section.

For full information on the use of HTH Tablets for the disinfection of new mains, ask your HTH supply house or write today.

MATHIESON CHEMICALS

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INDUSTRIAL WASTE TREATMENT

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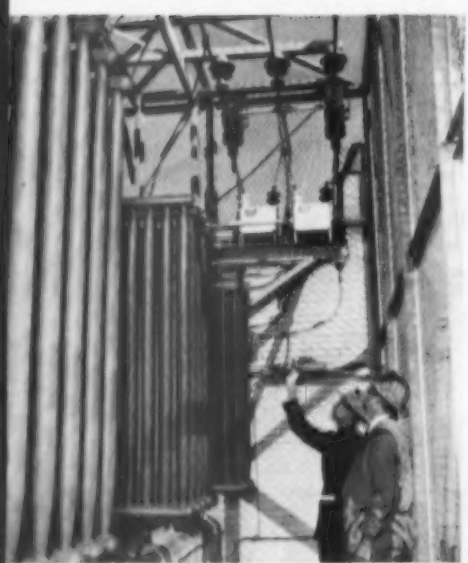
LITTLE MIAMI SEWAGE TREATMENT PLANT
—first step in Cincinnati, Ohio's program to provide modern sewage treatment and disposal facilities. Consulting Engrs.: Havens and Emerson. Gen. Contractor: James McHugh Constr. Co., Inc.



FACT: Reliable electrical service starts at this city-owned substation, adjacent to the plant. Three 333-kva, single-phase Westinghouse transformers step down utility power from 13.2 kv to 480 volts.

FACT: Service continuity on the entire electrical system stems from this Westinghouse switchboard, distributing at 480 volts. Air circuit breakers protect the main circuit and 10 branch feeders.

FACT: Westinghouse "De-ion®" circuit breaker panelboards at key distribution points protect plant's services. Westinghouse dry-type transformer, top, reduces voltage for lighting and instruments.

FACT:

Westinghouse distribution equipment serves Cincinnati's new sewage treatment plant

ELECTRICAL SYSTEM DESIGNED TO MATCH LITTLE MIAMI PLANT'S ULTIMATE CAPACITY OF 30,000,000 GALLONS A DAY

FACT: Dependable power in Cincinnati's Little Miami Sewage Treatment Plant is assured by a coordinated installation of three 333-kva transformers, a 480-volt switchboard, lighting and power panelboards, dry-type transformers and motor control . . . all matched for operating simplicity and plant efficiency.

FACT: Positive protection of valuable equipment is provided by using Westinghouse circuit breakers throughout the distribution system . . . and circuit breakers are safe.

For the full case history and the Westinghouse team that helped coordinate it electrically . . . J-94034

Call *The Man With The Facts* . . . the construction sales engineer in your nearest Westinghouse office

YOU CAN BE **SURE**... IF IT'S
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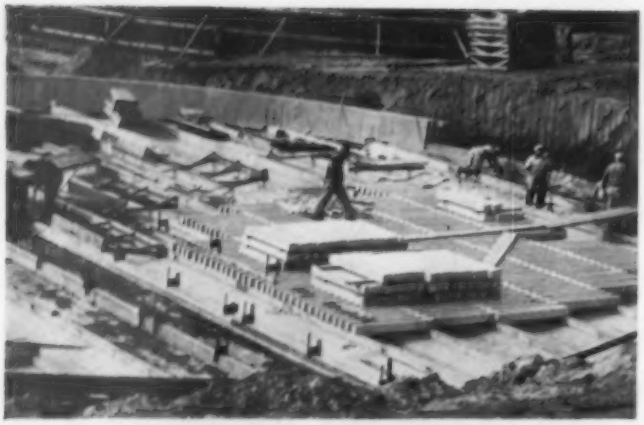

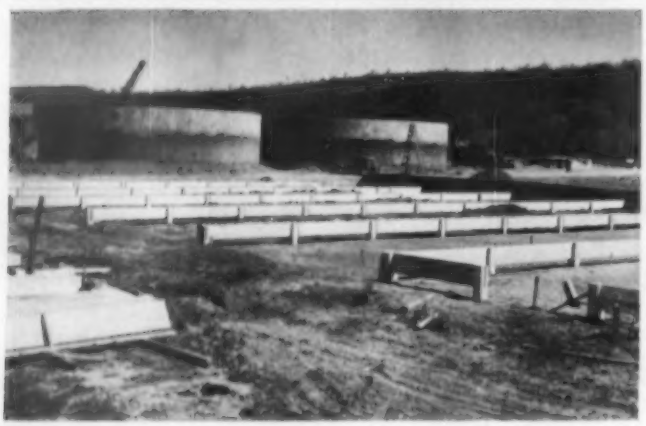

Precast
CONCRETE UNITS
offer many advantages for Modern Sewage Treatment Works

Precast concrete units are being used more and more in sewage treatment plant facilities. There's a good reason. Precast concrete units offer all the advantages of conventional concrete construction—plus speed, economy and easy handling. Here are typical recent examples:

FILTER UNDERDRAINS of the six trickling filters in the East Providence, R. I. Sewage Treatment Plant are precast, reinforced concrete beams (top photo). Because of concrete's great strength they could be used as cribbing to support the weight of the crushed traprock filter medium.

DIGESTER COVERS in the East Providence plant (second photo) are 2-in.-thick, tongue-and-groove precast concrete planks. Since concrete resists rot in a damp atmosphere, it was chosen over less durable materials.

Covers for the digester tanks of the Benton Harbor-St. Joseph, Mich. Sewage Treatment Plant (third photo) are short slabs of precast concrete that rest on purlins connecting radial girders. Crevices between slabs are calked with mastic. Triangular spaces between slabs and girders are filled with grout. Covers are 80 ft. in dia., rise 3 ft. from the outer edge to the center.

SLUDGE BED PLANKS AND POSTS in Elmira, N. Y. Sewage Treatment Plant are precast concrete units (bottom photo), part of a million-dollar plant addition. Durable precast concrete units can withstand a lifetime of weathering and freeze-thaw cycles in such installations.

Precast concrete construction is moderate in first cost, requires little maintenance, serves for years. The result is ***low annual cost,*** the real measure of the economy of any construction.

For more information, write for a free illustrated booklet, *"Sewage Treatment Works."* It is distributed only in the United States and Canada.

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These safety advantages are yours in the Fischer & Porter Chlorinator. They cost you not one penny more at the outset, since the F&P Chlorinator is lower in first cost. They avoid constant costs of repeated safety tests and checks. They assure you against high costs of repairs and maintenance. We don't put our safety devices under a bell jar—they are right out in the open where you can see and touch them.

These engineered features—*instrument-type engineering*—make the F&P Chlorinator the safest ever built. And you get all these safety features *plus* ease of operation, dependability proven in over 600 operating units, complete corrosion resistance—everything you should have in a chlorinator—and you get them for even less cost in the initial purchase. Write today for full information, details on free trial offer, and *absolute guarantee of satisfaction.*

complete process instrumentation

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18 YEARS SUCCESSFULLY MANUFACTURING CHLORINE CONTROL EQUIPMENT

America's Largest Standpipe

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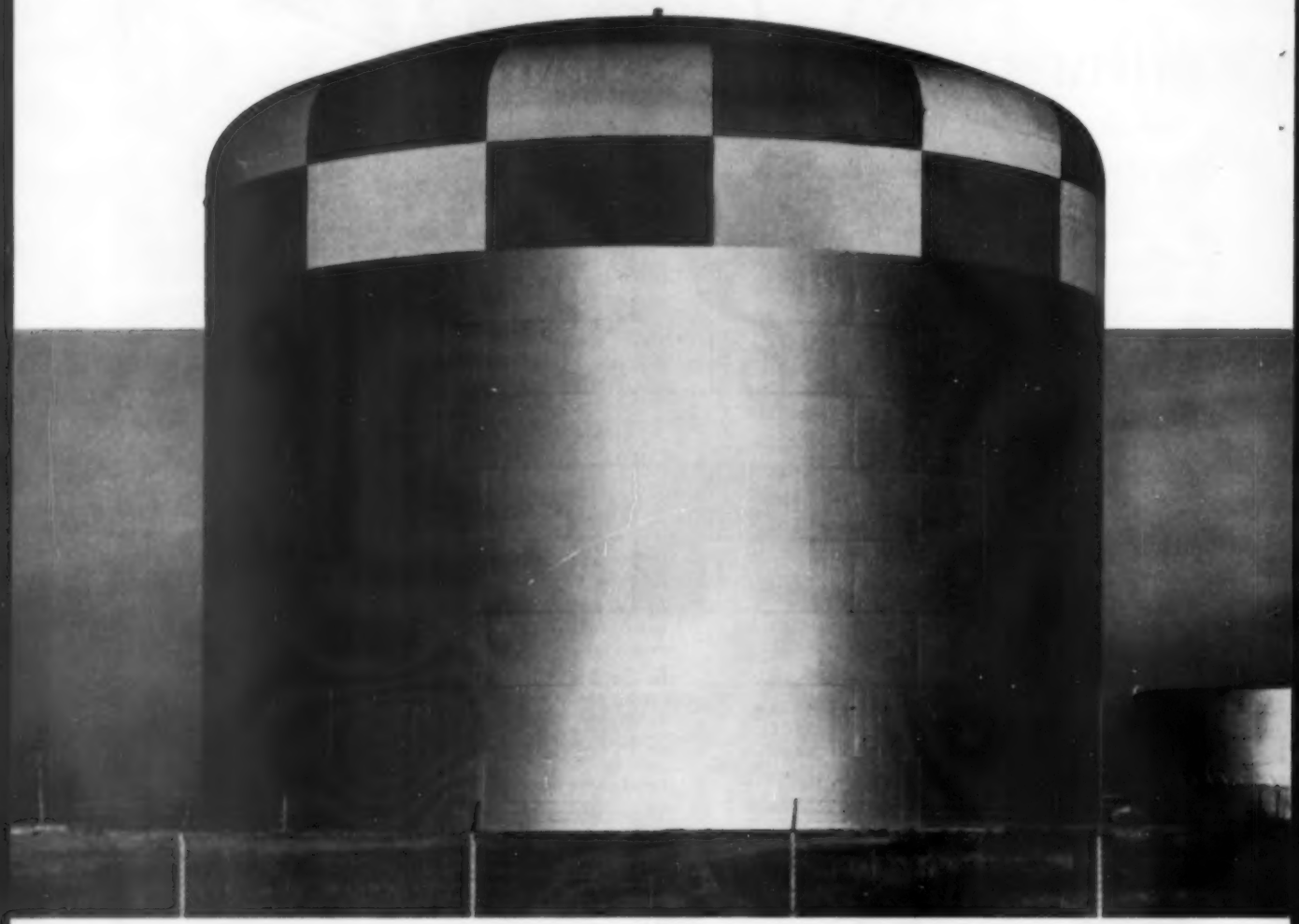

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This huge water storage unit evidences typical Pittsburgh-Des Moines fine workmanship in shop fabrication and field erection. Measuring 116 feet in diameter, with a water depth of 95 feet and total capacity of 7,268,000 gallons, the South Pittsburgh Water Company giant is the largest standpipe-type storage tank built in America to date. • Let us quote on your water storage needs.

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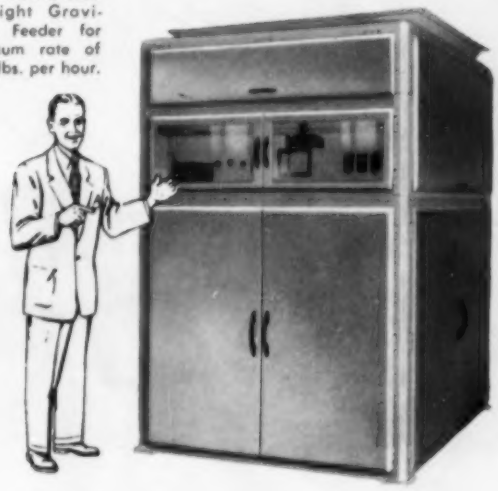
Model GLW-1 Loss-in-Weight Gravimetric Feeder for maximum rate of 1,000 lbs. per hour.

Model GLW-2 Loss-in-Weight Gravimetric Feeder for maximum rate of 4,000 lbs. per hour.



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what have

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In good condition after 100 years of service, this cast iron water distribution main is one of several still functioning in New York City.

MODERNIZED cast iron

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THE ELEPHANT AND CAST IRON PIPE...STRENGTH!

Great strength has made the elephant one of Man's most useful animals. And Cast Iron's strength . . . shock strength, beam strength, compressive strength, make it the world's most dependable pipe . . . servant of centuries.

AND HERE'S THE PROOF: Listed below are some of the many water utilities still using cast iron pipe that was installed a century or more ago.

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TODAY... modernized cast iron pipe, centrifugally cast, is even tougher, stronger, more uniform. *Where needed and specified,* it is centrifugally lined with cement mortar to assure sustained carrying capacity throughout its long years of service.

CAST IRON PIPE'S PROVED RECORD OF DEPENDABILITY IS UNIQUE IN ITS FIELD.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3.

CAST Q IRON

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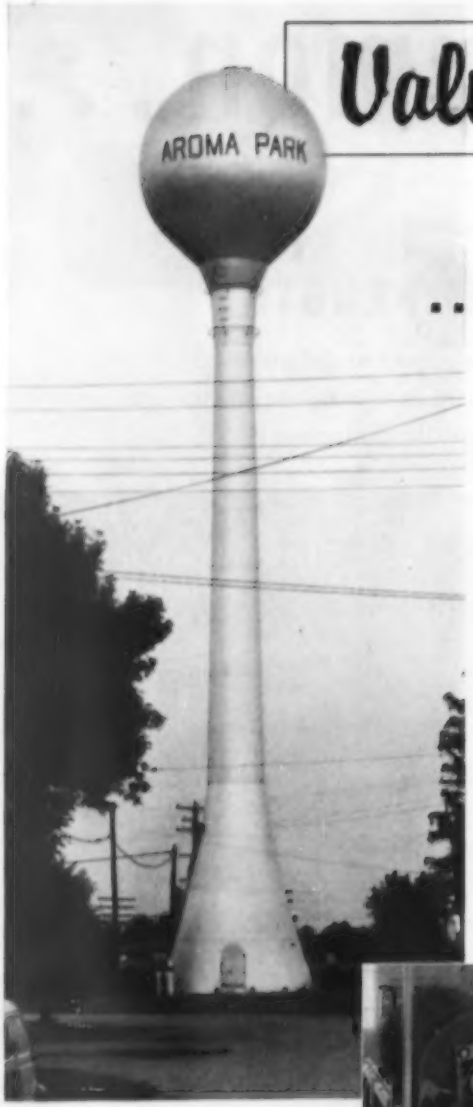
pipe FOR MODERN WATER WORKS OPERATION

Values to Recognize

...Horton Watersphere...

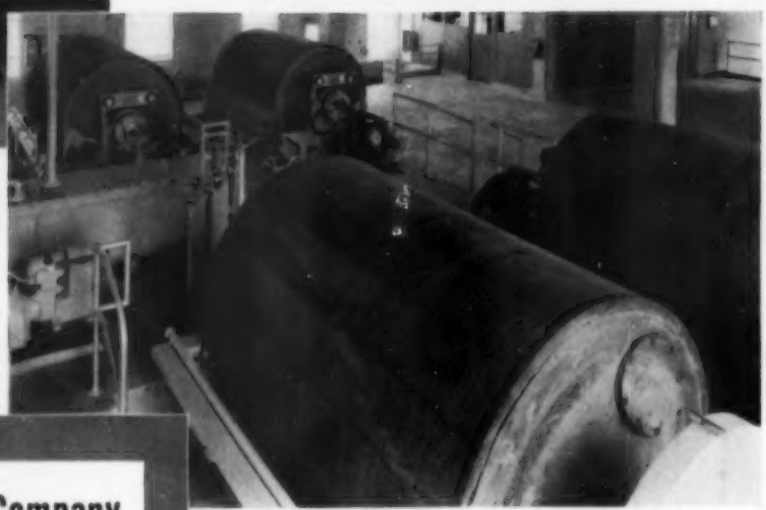


Above: 50,000-gal. Horton Watersphere built for Aroma Park, Illinois. The base of the Watersphere is used as a pump house.

Here are some values that municipal and consulting engineers will be quick to recognize: (1) The Horton Watersphere®, a modern streamlined structure that provides a dependable gravity pressure water supply, striking appearance and a minimum surface area to maintain, (2) Conkey Sludge Filters, in use dewatering over two thousand tons of dry solids from sewage and industrial wastes at installations throughout the nation. There are other values at CB&I, including four completely equipped plants and experienced engineering, fabricating and erecting crews.

Solve your water distribution system and industrial wastes disposal problems by writing the nearest CB&I office.

Conkey Sludge Filters



Above: Conkey Sludge Filters designed for dewatering 225 tons of digested elutriated ferric chloride flocculated sewage sludge daily at the Little Miami Sewage Works, Cincinnati, Ohio.

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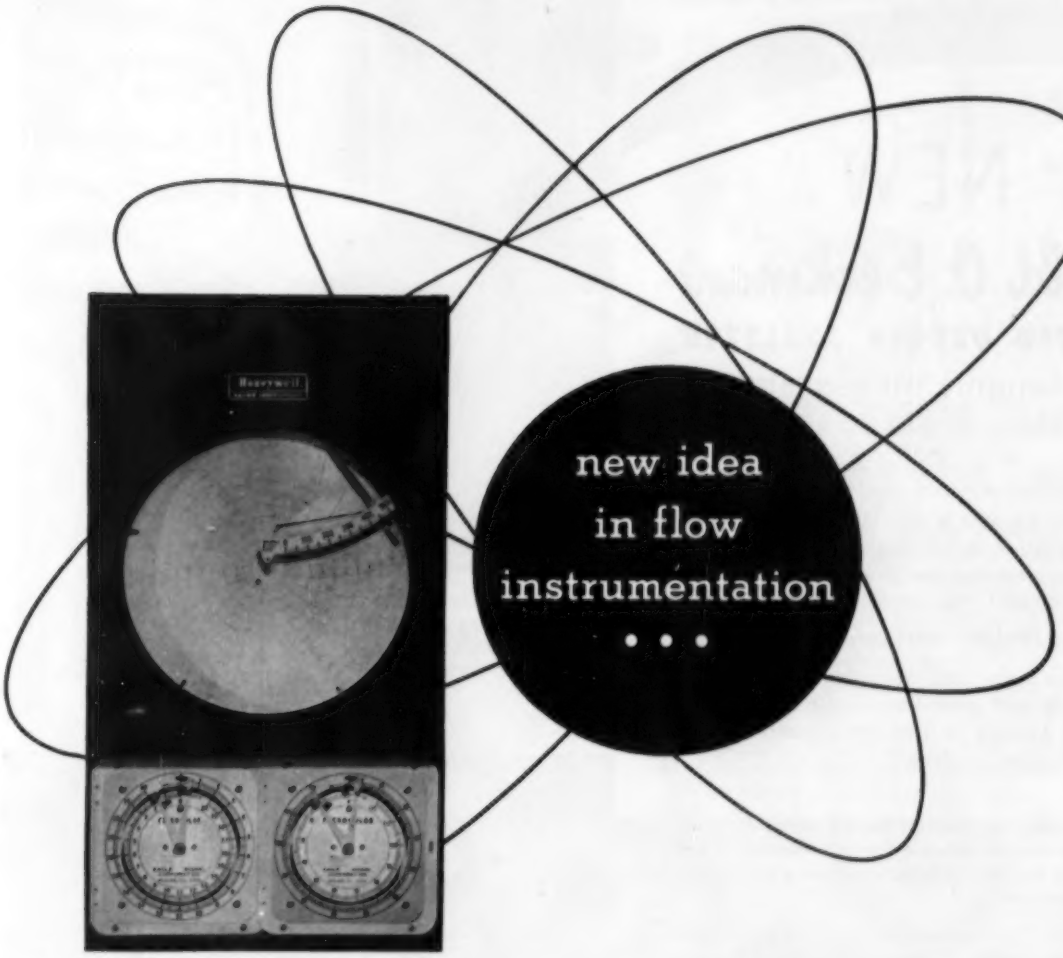

provides automatic sequence control

WATER treatment processes and sewage disposal plants will find many applications for this new addition to the line of Brown flow instruments. Consisting of a flow recorder with electronic integration, this instrumentation initiates control action whenever a specified volume of fluid is transferred. It can be used, for example, to start chemical feeders when a preset gallonage of water is pumped into a treatment tank . . . and then to shut off the feeder after a pre-determined running time.

Useful in both batch and continuous operations, this instrumentation places on an accurate, automatic basis many processes which have always required constant attention by operators. It not only eliminates the danger of human errors, but also frees personnel for other more responsible duties.

Control starts from the integrated measurement. When a given volume (or poundage) has been transferred, a timer is actuated to start the related control circuit. Many variations are possible, to afford control based either on constant feed for a variable time duration, or on variable feed. The control instrument can be a flow-measuring model; or if transfer of solids is involved, any of several systems for continuous weighing of materials on conveyors can be utilized.

Your local Honeywell sales engineer will be glad to discuss applications to specific problems, with you and your consulting engineer. Call him at your nearby Honeywell office . . . as near to you as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA: Write for Instrumentation Data Sheet No. 11.12-1.**

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BROWN INSTRUMENTS

First in Controls

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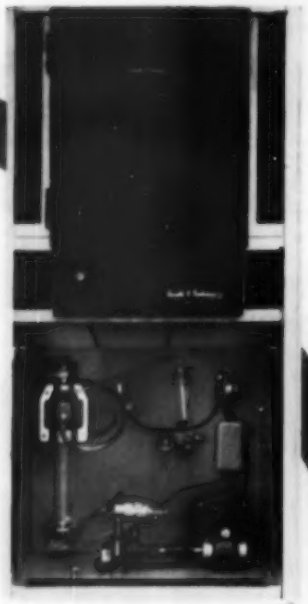
Arnold O. Beckman
DISSOLVED OXYGEN ANALYZER
for continuous measurement!



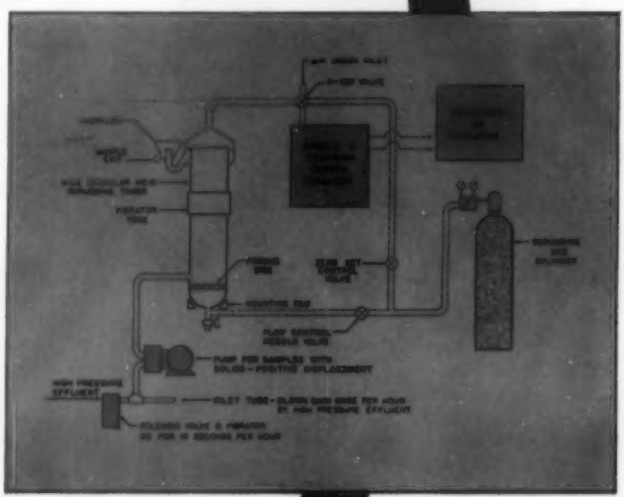
- Continuous record
- Handles fluids, slurries, sludges, etc.
- Simple operation
- Highly accurate

The Model 1A3B is a complete, compact unit—with the Analyzer in top compartment and the scrubbing unit below.

The accurate measurement of dissolved oxygen in fluid process streams is widely recognized as an important control factor in such municipal and industrial operations as sewage and water treatment . . . waste disposal . . . petro-chemical and chemical processes . . . food processes . . . and many others.

Now, you can make such measurements—continuously, simply and accurately—with the newly-developed Arnold O. Beckman Model 1A3B Dissolved Oxygen Analyzer!

- **The new Model 1A3B combines the field-proven Arnold O. Beckman paramagnetic principle of oxygen measurement with an improved method of stripping to provide a measurement specific for oxygen.**
- **The Model 1A3B is factory-calibrated to read in percent saturation so that efficiency of aeration or deaeration is shown directly. Or if preferred, the instrument can also be supplied to provide readings directly in parts-per-million.**
- **The Model 1A3B can be directly connected to any standard potentiometer-type recorder or indicator. No special accessory equipment is needed.**
- **Using the Model 1A3B is far superior—in speed, accuracy and convenience—to conventional chemical methods—and provides—immediately and continuously—the necessary control information for maintaining optimum processing uniformity.**



The Principle is simple and po[illegible]ne constantly-fresh test sample in scrubbing tower is stripp[illegible]olved oxygen by inert scrubbing gas—and result measured [illegible]yzer. Measurement is continuous and accurate!

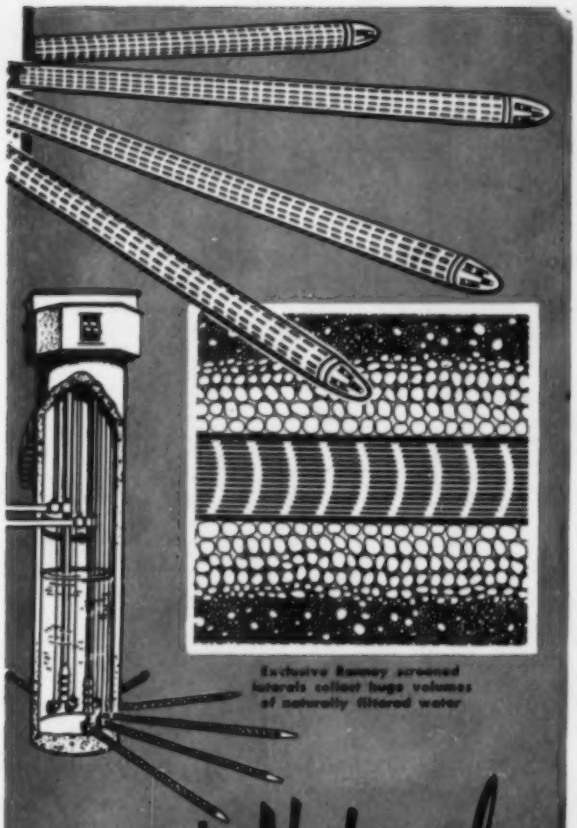
With a few variations the Model 1A3B can be adapted to a wide range of application requirements . . . to handling sludges and other liquids having high concentration of solids . . . to handling samples under abnormal pressures or temperatures . . . and to other difficult sampling conditions.

RANGES—from a m[illegible] 0-100% O_2 saturation to a minimum of 0-5 ppm, full scale. I[illegible] ranges are also available.

Arnold O. Beckman INC.

[illegible], SOUTH PASADENA, CALIFORNIA

Get the full story *on this new Arnold O. Beckman development by writing directly for information on the Model 1A3B Dissolved Oxygen Analyzer. Ask for Data File # 13R—25.*



Exclusive Ranney screened laterals collect huge volumes of naturally filtered water

The Ranney Method Assures a Pure, Sanitary Water Supply

Natural Filtration

The RANNEY METHOD, by Natural Filtration, produces water of better chemical quality than ground water . . . as proven by the many RANNEY installations now in operation. Each delivers millions of gallons per year of clear, non-turbid water at lowest cost. The RANNEY method reduces, or eliminates entirely, costly filter plants.

If you need an efficient, economical water supply...

write

RANNEY METHOD

Water Supplies Inc.

Water Supply Engineers and Contractors

841 Alton Columbus 19, Ohio

DEPT. WS-4

Associate:
Ranney Method Western Corp.

When Pressure Drops in the Mains...

Pressure Increases on the Engineer

The rapid postwar growth of both population and industry has been the cause of critical water distribution problems in practically every community.

Weinman Centrifugal Pumps have been chosen by many civic water divisions for service at booster station points in their distribution systems, to provide efficient, dependable pumping under widely varying heads and discharge requirements. Developed by experienced pump engineers, Weinman Pumps are available for high, medium and low head requirements, with single or dual-drive; and for extremely high head conditions, mounted in series to deliver the equivalent of two-stage equipment.

Five 8-inch Horizontal Split Case Weinman Type L2 Double Suction Centrifugal Pumps help provide needed pressure in the new Fisher Road Booster Station of the Columbus, Ohio, Division of Water.

Your community can benefit from dependable Weinman Pump performance. Modern hydraulic and mechanical design, plus precision manufacture from quality materials, make them the best, as well as the most economical buy in centrifugal pumps for any purpose. Write, wire or phone for complete information and illustrated brochure covering Weinman Pumps for your particular requirements.

Representatives in principal cities

Built by Centrifugal Specialists

The WEINMAN Pump Mfg. Co.

TAUNTON reports...

"Not a Service call in 2½ years"

These two Builders Model CVS Chlorinizers have been in service at the Taunton, Mass. Sewage Treatment Plant (designed and engineered by Fay, Spofford and Thorndike) since late 1949. Paul Manter, Chief Operator (shown in the photo) has nothing but praise for the Chlorinizers. During the past 2½ years, he reports there hasn't been a call for service of any kind on these machines. Mr. Manter now expects the Chlorinizers will give two to three times more effective service life than originally estimated.

This kind of performance explains why Builders Chlorinizers are gaining such wide acceptance for all types of chlorination assignments. Whatever control system you use . . . manual, program, semi-automatic, or flow-proportional . . Chlorinizer will save you money and simplify your operating problems. Write for bulletins giving complete details on the four basic models of Builders Chlorinizers. Builders-Providence, Inc., 350 Harris Ave., Providence 1, Rhode Island.

BUILDERS-PROVIDENCE

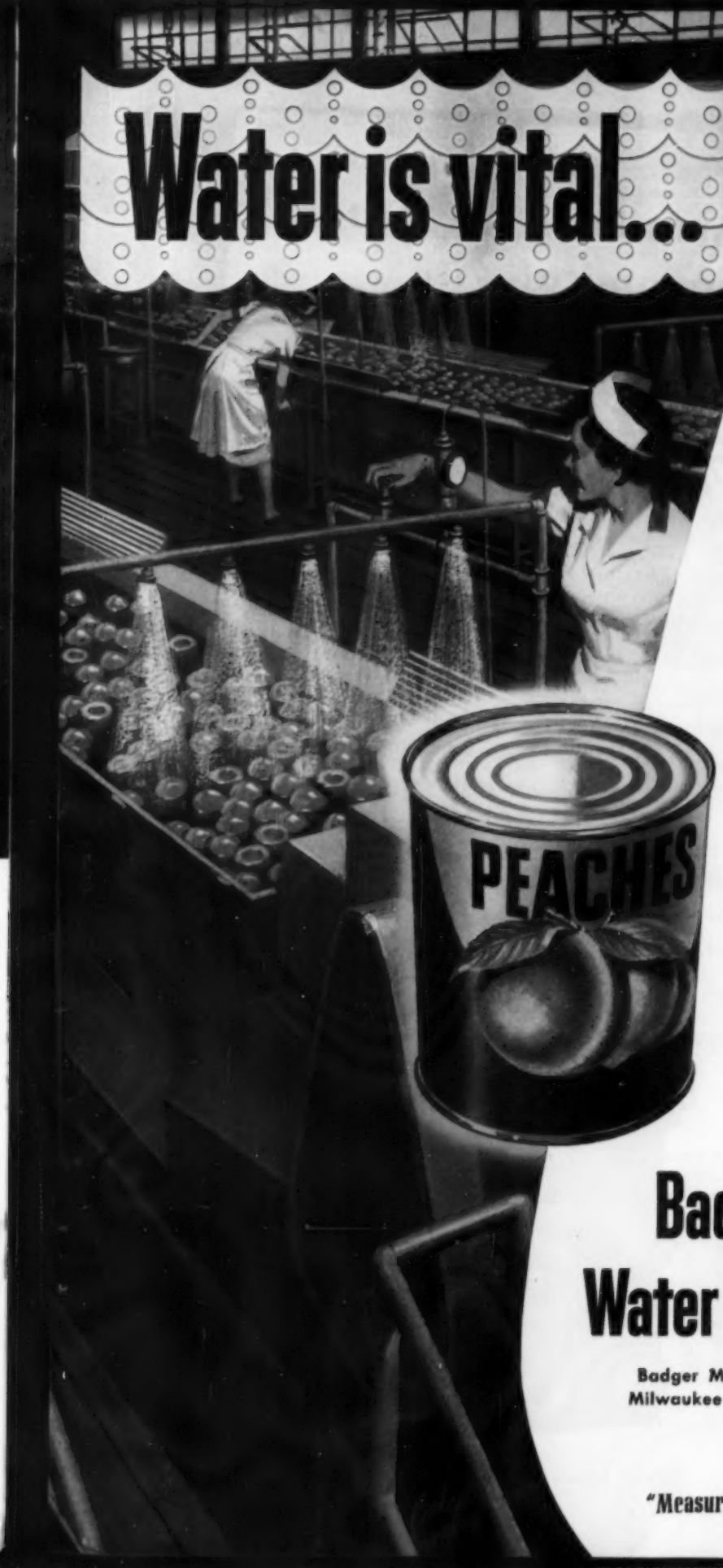
DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

B-I-F METERS FEEDERS CONTROLS

Water is vital...

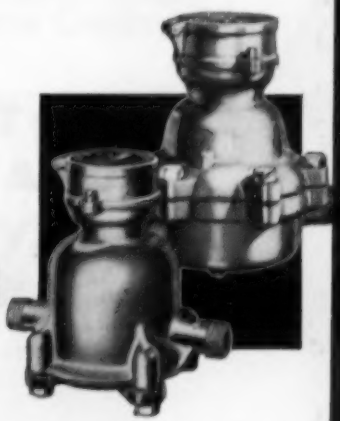
Badger meters conserve it better!



More than 37-billion cans of food were used by American families last year . . . yet it took *more water than produce* to make these canned products available. For example, more than 15 pounds of water were required for every pound of canned vegetables sold.

Little wonder, then, that Badger meters serve so importantly in thousands of communities. They make certain that homes and industries receive a fair share of the water supply . . . pay only for the water they use.

Famous Badger meters measure water precisely . . . help eliminate waste . . . make water departments more efficient and self-supporting. And service records prove the dependability of Badger meters . . . prove that there are no finer water meters to be had — anywhere!



Badger Water Meters

Badger Meter Mfg. Co.
Milwaukee 45, Wisconsin

"Measuring the water of the world for 50 years"

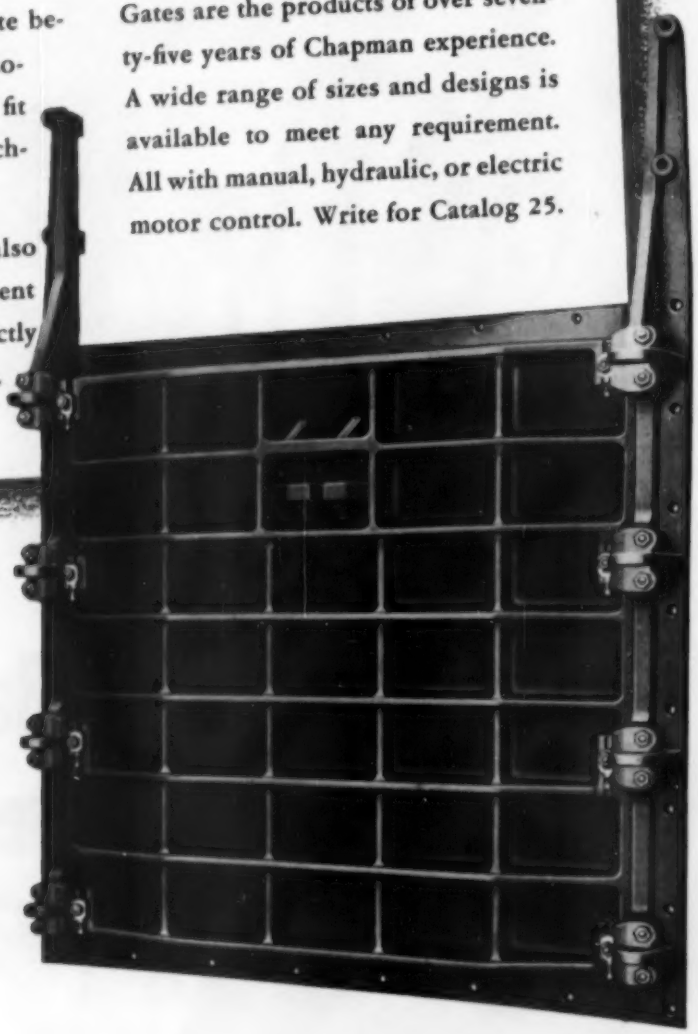
Here's Why Installation is Faster, More Economical with

CHAPMAN
Standard
SLUICE GATES

Installation is faster and simpler with a Chapman Standard Sluice Gate because component parts are absolutely interchangeable, made to fit every installation without match-marking or field alterations.

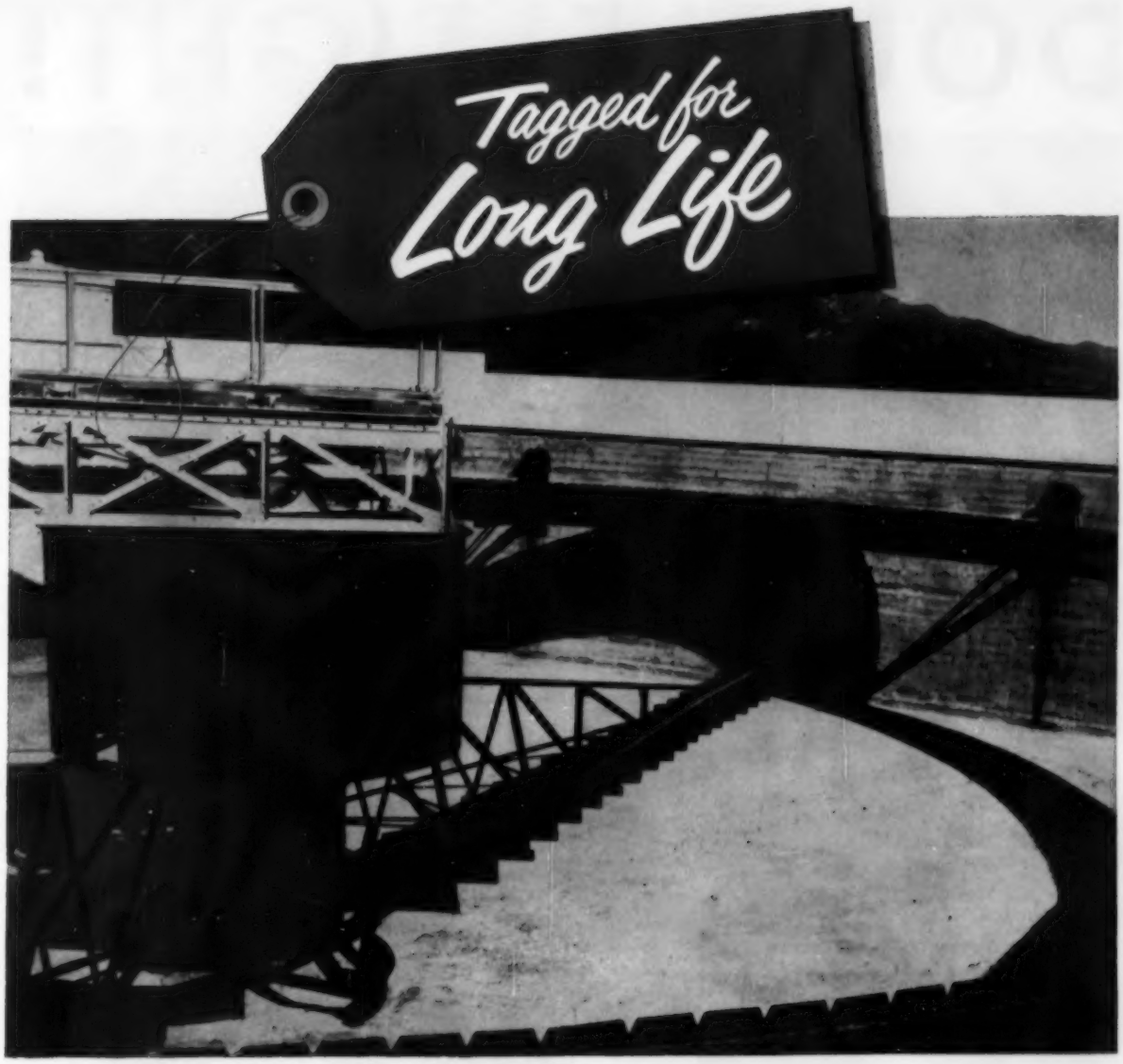
Standardized manufacture also means that repair or replacement parts, if necessary, fit perfectly into place without alterations.

Modern Chapman Standard Sluice Gates are the products of over seventy-five years of Chapman experience. A wide range of sizes and designs is available to meet any requirement. All with manual, hydraulic, or electric motor control. Write for Catalog 25.



THE CHAPMAN VALVE MFG. COMPANY

INDIAN ORCHARD, MASS.



. . . because it's protected with PITT CHEM® Tar Base Coatings

THIS water system clarifier tank is getting the right start in life. It's being given "life insurance" with Pitt Chem 103 Tar Base Coating—one of the toughest and most durable protective coatings ever developed to stop water and sewage plant corrosion.

Pitt Chem Tar Base Coatings outlast ordinary paints by many times. Yet they cost no more per gallon. They are easy and economical to apply and form a tight, lasting bond with metal, masonry, concrete and stone.

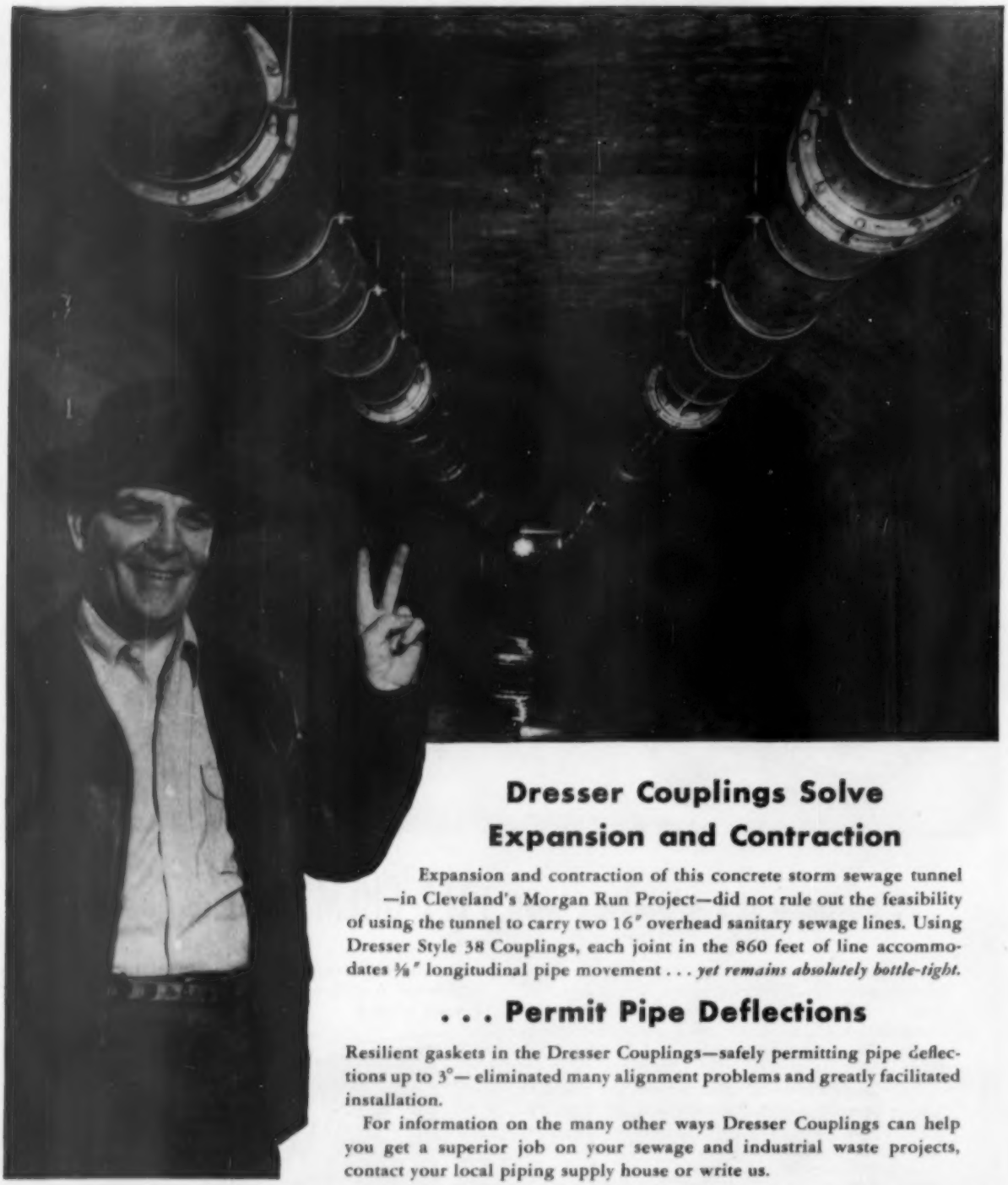
Here's the story in a nutshell: *No other material does such a complete job of protection at so little cost.* If you want to stop water sewage corrosion—and reduce costs in the bargain—call for a Pitt Chem corrosion engineer today to survey your specific problems. A call, wire or letter will place him at your service.

PITTSBURGH
COKE & CHEMICAL CO.

W&D 5455

COAL CHEMICALS • AGRICULTURAL CHEMICALS • FINE CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

DOUBLE-TIGHT!



Dresser Couplings Solve Expansion and Contraction

Expansion and contraction of this concrete storm sewage tunnel —in Cleveland's Morgan Run Project—did not rule out the feasibility of using the tunnel to carry two 16″ overhead sanitary sewage lines. Using Dresser Style 38 Couplings, each joint in the 860 feet of line accommodates ⅜″ longitudinal pipe movement . . . *yet remains absolutely bottle-tight.*

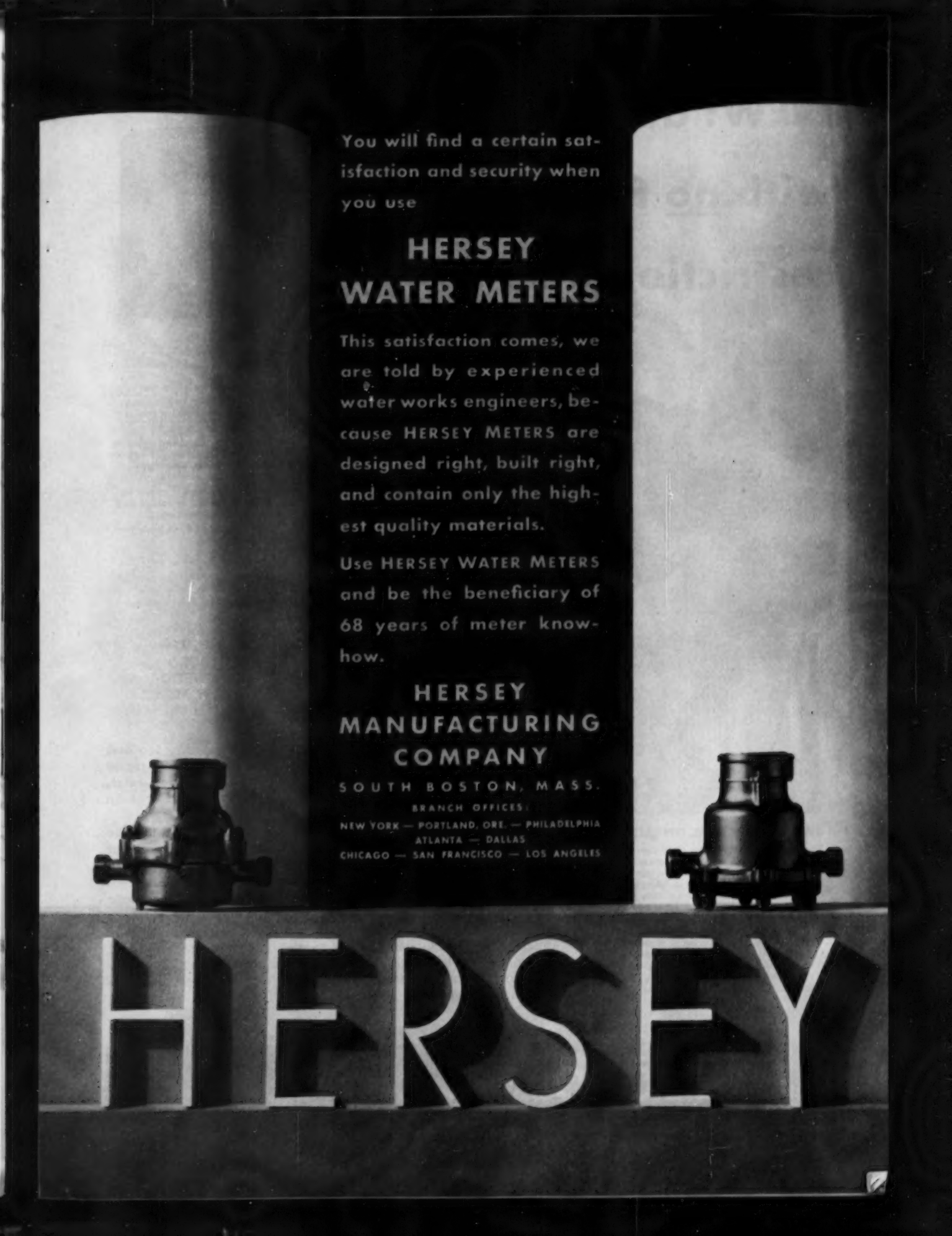
. . . Permit Pipe Deflections

Resilient gaskets in the Dresser Couplings—safely permitting pipe deflections up to 3°— eliminated many alignment problems and greatly facilitated installation.

For information on the many other ways Dresser Couplings can help you get a superior job on your sewage and industrial waste projects, contact your local piping supply house or write us.

DRESSER.

Dresser Manufacturing Division, 69 Fisher Ave., Bradford, Pa. (One of the Dresser Industries). Warehouses: 1121 Rothwell St., Houston; 101 S. Airport Blvd., S. San Francisco. Sales offices also in: New York, Philadelphia, Chicago, Toronto.


You will find a certain satisfaction and security when you use
HERSEY
WATER METERS
This satisfaction comes, we are told by experienced water works engineers, because HERSEY METERS are designed right, built right, and contain only the highest quality materials.
Use HERSEY WATER METERS and be the beneficiary of 68 years of meter know-how.
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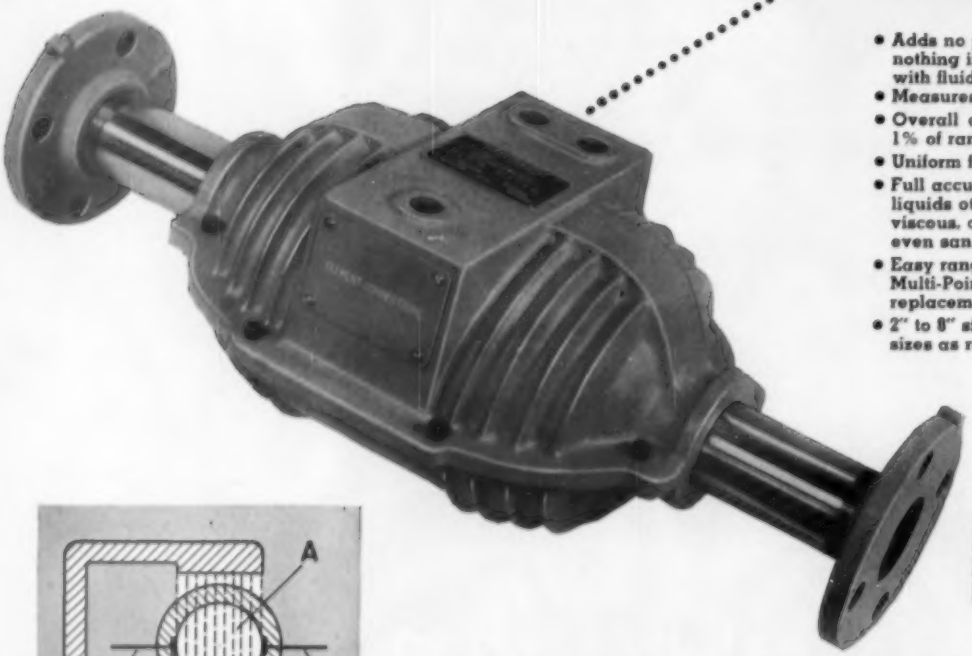
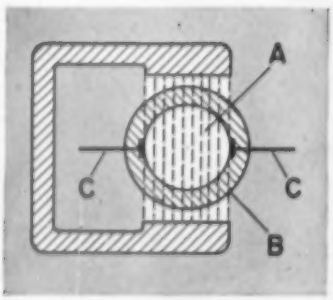
ATLANTA — DALLAS
CHICAGO — SAN FRANCISCO — LOS ANGELES
HERSEY

NEW! a flow meter with no flow restrictions!



- Adds no pressure drop — nothing inside pipe to interfere with fluid flow.
- Measures fluid velocity directly.
- Overall accuracy better than 1% of range over entire scale.
- Uniform flow scale.
- Full accuracy sustained even on liquids other meters can't handle: viscous, corrosive, or pulpy — even sand-water slurries.
- Easy range change — either by Multi-Point Switch or range coil replacement, as preferred.
- 2" to 8" sizes standard — larger sizes as required.

FOXBORO MAGNETIC FLOW METER



SIMPLE, TROUBLEFREE, OPERATION

The Foxboro Magnetic Flow Meter operates on the same principle as a power generator. A magnetic field (A) is maintained through a standard pipe section (B) of stainless steel or other non-magnetic material. This pipe section is lined with Kel-F® or other insulating material. Liquid passing through pipe acts as moving conductor, generating an electric voltage which varies in proportion to liquid's average velocity. Flush electrodes (C) in pipe wall "pick up" this voltage which is recorded in desired flow units by Dynalog Electronic Recorder or Controller.

This premium-performance meter measures *magnetically* the flow rate of virtually any liquid except hydrocarbons. It completely ignores such common metering headaches as turbulence, suspended solids, and variations in conductivity, density, and viscosity. It even measures reversing flows.

Installation is simple. The magnetic spool piece connects into the line like any equivalent length of pipe — no seals, purges, meter runs, or straightening vanes required. Connects by 2-conductor cable to remote Dynalog Electronic Flow Recorder.

Maintenance is practically eliminated. There are no pressure taps to become plugged or frozen, no working parts to foul.

Foxboro Magnetic Flow Meters are already in use on such widely different liquids as beer, sand-and-water, rosin size, rock-and-acid slurry, viscose, and highly corrosive liquid detergent. Find out how this precise, troublefree flow meter can help *your* processing. Write for complete details.

THE FOXBORO COMPANY, 894 NEPONSET AVENUE, FOXBORO, MASS., U. S. A.

FOXBORO
REG U S PAT OFF

Foremost in FLOW METERING

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

MUELLER

DRILLING MACHINES

...have broad application

Install control valves... connect branch mains... perform a wide variety of other water works operations...under pressure...makes cuts 2" through 12" in any type pipe...25" boring bar travel...working pressures to 500 p.s.i...working temperatures to 550° F... used with Mueller Inserting Valves, Tapping Sleeves and Valves, Gate Valves and special fittings.

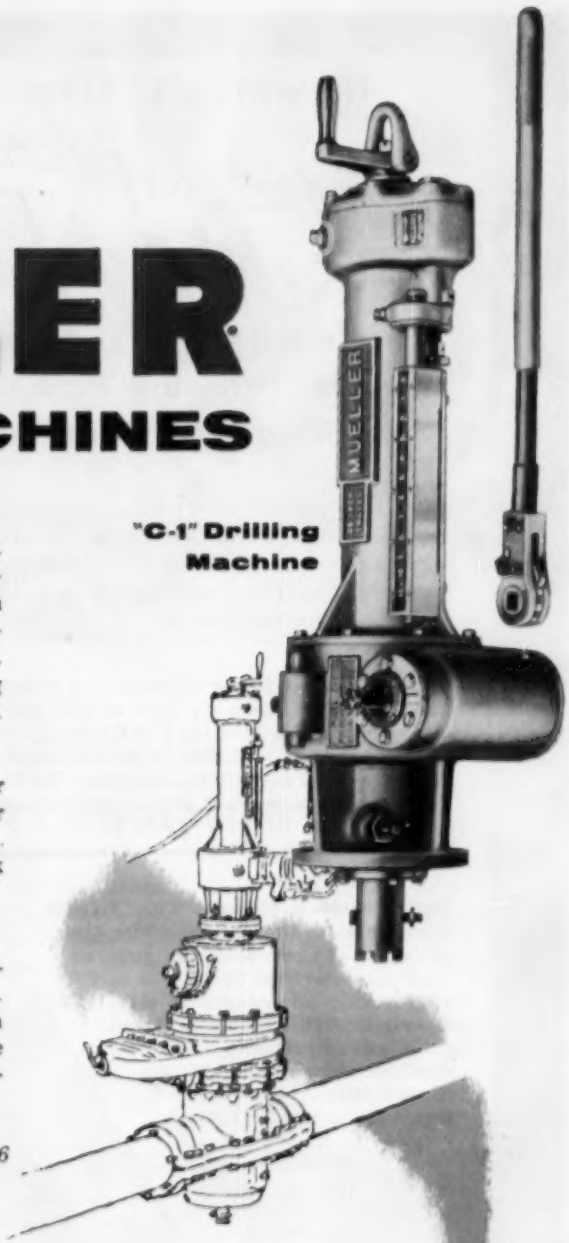
...are easier to operate

Positive automatic feed for drilling... hand feed for rapid advance and withdrawal... hand or power operated... air or gasoline engine power units... feed indicator standard equipment... stuffing box adjustment during cutting.

...will last longer

All working parts completely enclosed in tight, oil-filled case... perfect lubrication... free from dirt... telescopic construction for compactness, strength and rigidity... special design prevents line pressure from entering gear case... ball thrust bearings reduce friction and wear... Fully Warranted.

Consult your Mueller Representative, your Mueller W-96 Water Works Catalog or write direct for full details.

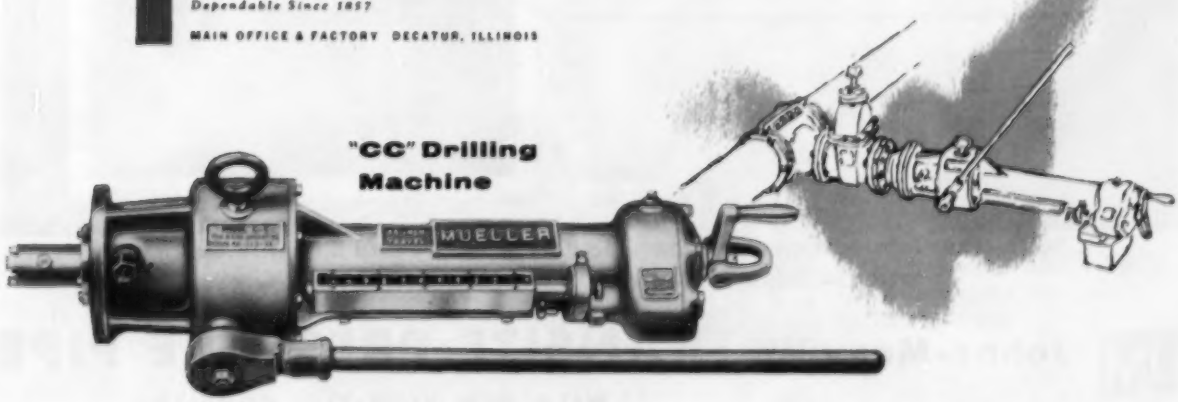


"C-1" Drilling Machine

MUELLER CO.

Dependable Since 1857

MAIN OFFICE & FACTORY DECATUR, ILLINOIS



"CC" Drilling Machine

IN WATER SYSTEMS

Installed cost plus performance is what counts!

That's why it pays to use Transite® Pressure Pipe with the Ring-Tite® Coupling

FOR THE contractor who installs it . . . for the engineer who selects it . . . for the taxpayer who pays for it . . . Transite Pressure Pipe with the new Ring-Tite Coupling meets every requirement. For example . . .

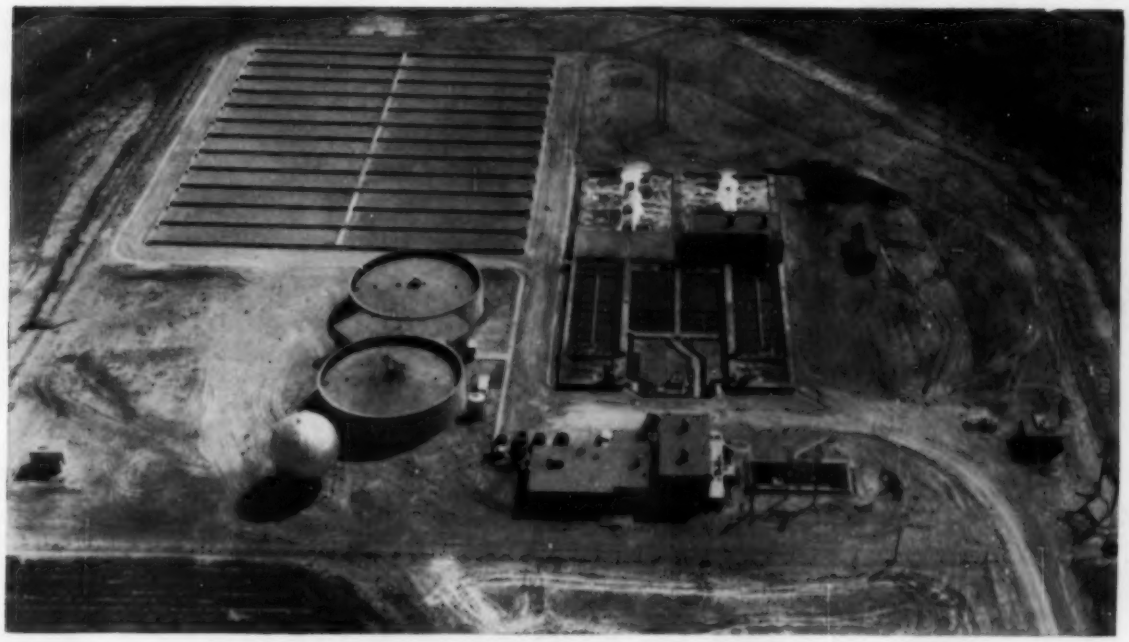
Installed Cost is Lower—Contractors everywhere have found that Transite's light weight, easy handling and fast, accurate Ring-Tite Coupling simplify assembly and save time. May be installed even under difficult weather and terrain conditions. The Ring-Tite design automatically locks tight, forming a positive seal.

Performance is Higher—With Transite Pressure Pipe and the Ring-Tite Coupling, you can count on peak performance year after year because of such engineering advantages as these: *Lasting* strength because of Transite's asbestos-cement, a strong durable material, highly resistant to corrosion . . . *Designed* tightness with the rubber rings of the Ring-Tite Coupling . . . *Assured* flexibility with automatic end positioning within the joint . . . *Locked in the groove* . . . rings can't blow out.

For further information about Transite Pressure Pipe and Ring-Tite Coupling, write to Johns-Manville, Box 60, New York 16, N. Y.

Johns-Manville **TRANSITE PRESSURE PIPE**

WITH NEW RING-TITE COUPLING



At Enid, Oklahoma...

A plant is rebuilt for expandable treatment

WITH MODERN PFT EQUIPMENT

A population growth of nearly 30% in the last 10 years (now 36,000), rendered Enid's 1928 sewage treatment plant obsolete. City leaders looked far ahead in approving plans for a vastly improved system—a plant designed to permit *doubling* its capacity with a minimum of cost and effort!

Assisting the engineers in meeting specific plant requirements, PFT supplied the following equipment for modern "controlled digestion."

Two *PFT Floating Covers* for the 70′ digesters. The covers provide positive scum submergence for accelerated digestion and to safely utilize gas produced in the digester.

Two *PFT Cover Position Indicators* with low level alarms to allow checking of the liquid level in each digester from the operating floor of the control building.

Two *PFT Supernatant Selectors* (with Gauge, Sight Glass and Sampler units) for continuous withdrawal of the best digester liquor.

A *PFT Heater and Heat Exchanger* (750,000 B.T.U. per hr.) to keep digesters at optimum temperatures. Fired by sludge gas or natural gas, the unit saves fuel costs by utilizing all sludge gas produced, changing to natural gas only when necessary.

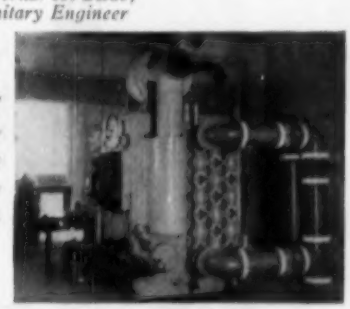
A *PFT Gravity Displacement Type Low Pressure Gas Holder* for compressor control.

In addition, PFT supplied many items of gas safety equipment: *Waste Gas Burner; Flame Traps; Pressure Relief with Waste Gas Flame Trap; Auxiliary Flame Cells; Accumulators; Drip Taps; Gas Pressure Gauge; Low Pressure Gas Check Valves.*

PFT assures the successful operation of its equipment by checking each installation and instructing plant operators in the proper methods of using its equipment.

Design of plant by / *Hudgins, Thompson & Ball Associates, Oklahoma City, Architect—Engineer; Bernal H. Swab, Sanitary Engineer*

PFT Heater and heat exchanger unit



P.F.T.

waste treatment equipment exclusively since 1893

PACIFIC FLUSH TANK CO.
4241 Ravenswood Avenue
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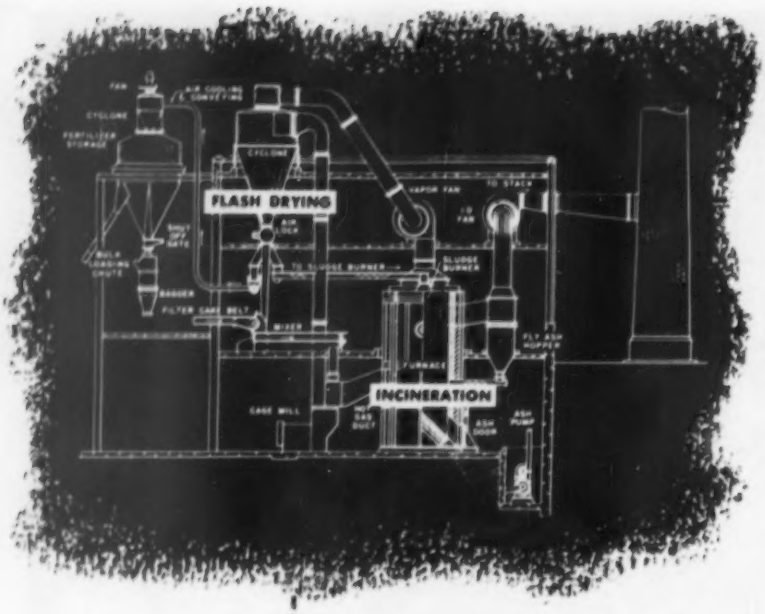
PORT CHESTER, N. Y. • SAN MATEO, CALIF. • CHARLOTTE, N. C. • JACKSONVILLE • DENVER



SOME FACTS ABOUT THE HEAT DISPOSAL of SEWAGE SLUDGE

Even though dried sewage sludge can often be sold at from $5.00 to $20.00 a ton – remember that is not *always* the case.

If sewage is contaminated – with grease, fiber, etc., for example – you may find the *only* thing to do is to incinerate the sludge. On the other hand, even though the sludge may not have the highest chemical analysis for fertilizer – it still can be marketed as a soil conditioner – thereby eliminating the ash disposal problem.

The C-E Raymond System of Flash Drying and Incineration is the most popular . . . most versatile on the market today. That's why you will find a C-E Raymond System to provide one or all of the following processes . . . controllably, accurately, economically:

1. **Flash Dry sludge.**
2. **Flash Dry and Deodorize.**
3. **Flash Dry and Incinerate.**
4. **Flash Dry, Incinerate and Deodorize.**
5. **Incinerate only.**
6. **Incinerate and Deodorize.**
7. **Flash Dry and Deodorize in conjunction with refuse and garbage incineration – plus incineration of sludge if desired.**

C-E Raymond Systems now in service or on order serve an equivalent population of more than 17,000,000 people – in communities ranging from 6,000 to 3,600,000 in population . . . in every section of the country, and even overseas.

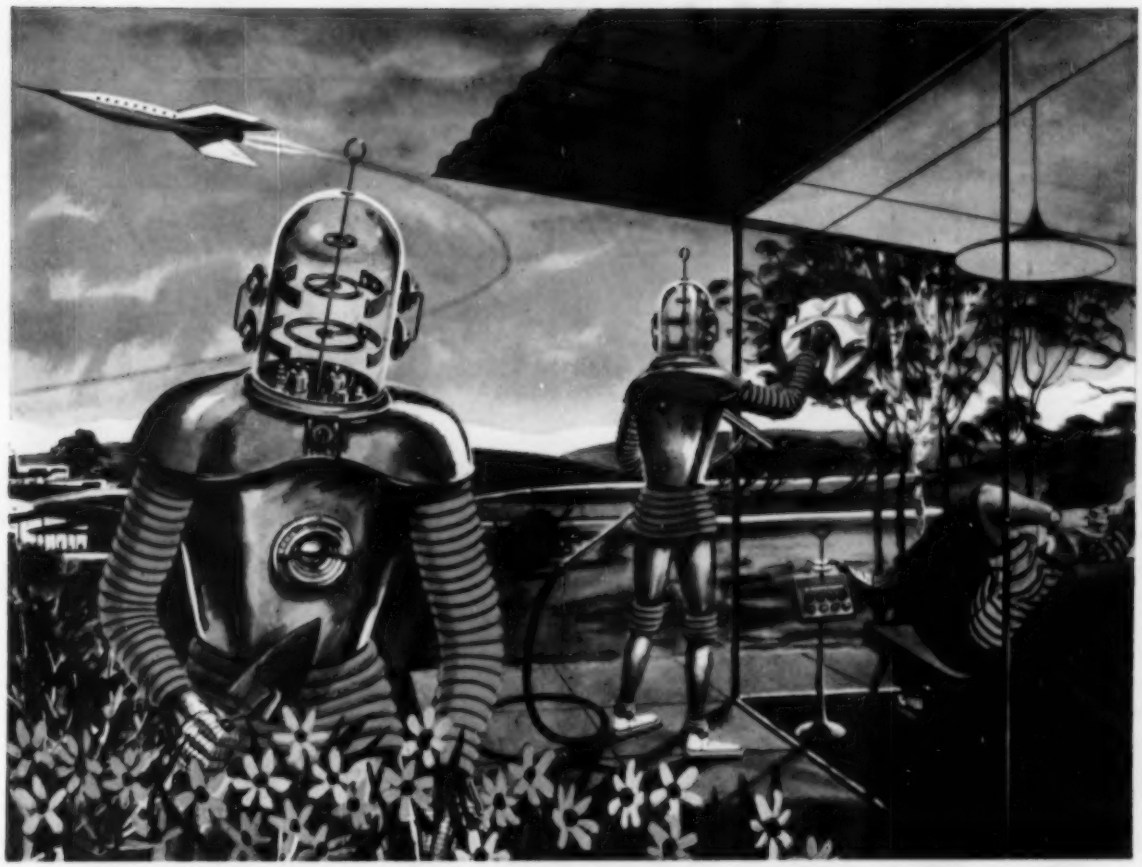
Whatever your requirements – there is a C-E Raymond System that will satisfy them precisely. Let one of our engineers show you or your consultants how this leading system of sludge disposal will work for you. B-772A

COMBUSTION ENGINEERING • **Raymond Division**

1315 North Branch Street, Chicago 22, Illinois • Eastern Office: 200 Madison Ave., New York 16, N. Y.

Western Office: 510 W. Sixth St., Los Angeles 14, Calif.

ALSO FLASH DRYING AND INCINERATION SYSTEMS FOR INDUSTRIAL WATER DISPOSAL



COMPETENT, BLOODLESS WORKERS . . . tireless, economical . . . electronically controlled and directed. These, science predicts, may be our "servants" of the future.

100 years from now...

ROBOTS MAY DO OUR WORK

The years ahead hold many surprises . . . wonderful new products and inventions to challenge the imagination. Then, as now, our water and gas will still be carried by the rugged, dependable cast iron pipe being laid today.

Over 60 American cities and towns are still served by cast iron water and gas mains laid over a hundred years ago. And today, modernized cast iron pipe, centrifugally cast and quality controlled, is even stronger, tougher, more durable.

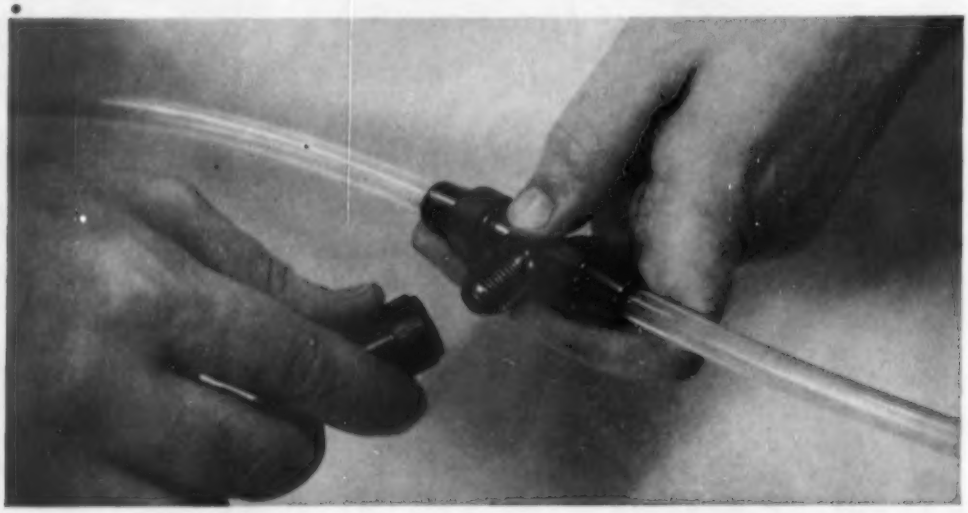
U.S. Pipe is proud to be one of the leaders in a forward-looking industry whose service to the world is measured in centuries.

U.S.
cast iron
PIPE
FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE
CAST IRON

U. S. PIPE AND FOUNDRY COMPANY, General Office: Birmingham, Alabama

A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE.

NOW - for complete plastic pipe service - just call Continental



MILLS PLASTIC I (SARAN)

FLEXIBLE – for air, oil and water lines, lubricating systems, food handling, beverages, vitamin oils and drugs, electrical raceways, etc.

MILLS PLASTIC III (BUTYRATE)

SEMI-RIGID – for salt-water disposal, vent lines, city water lines, renewal liners for gas lines, corrosive liquids and gases.

MILLS PLASTIC IV (POLYETHYLENE)

FLEXIBLE – for municipal water systems, two-pipe jet well transmission, underground water service, irrigation, transmission of corrosive gases, vapor, air, etc.

MILLS PLASTIC V (STYRENE-ALLOY)

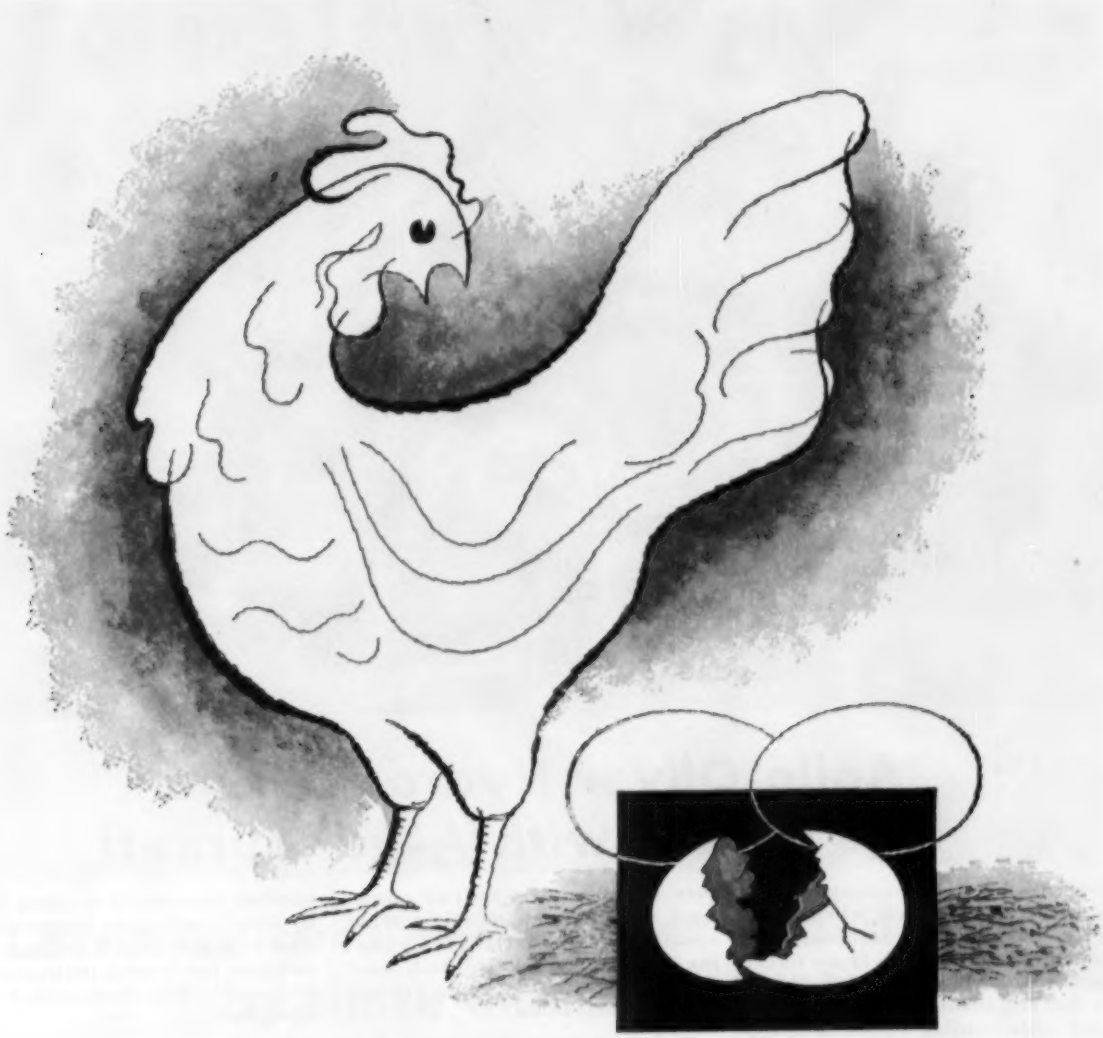
SEMI-RIGID – for use where corrosion is a major problem, including transportation of brine, sour crude, acids, natural gas. Non-toxic; recommended for food processing. Also excellent for electrical raceways.

Now Continental brings you *four* different types of plastic pipe. Our experts are ready and eager to help you pick the kind and size best suited to your purpose. In addition, we are now making the complete line of plastic fittings formerly maufactured by Tenco, Inc., of Winona, Minn. Whether you are handling water, food or drug products, chemicals, sour crude, salt water or natural gas, we can give you the best in plastic pipe and fittings at one call. May we hear from you soon? No obligation, of course.

CONTINENTAL CAN COMPANY

MILLS PLASTIC PIPE DIVISION

SALES OFFICE: 100 East 42nd Street, New York 17, N. Y.
FACTORY: 2930 North Ashland Avenue, Chicago 13, Ill.



STOP WASTING . . . PROFITS

In solving your waste treatment problems, Graver equipment can save the dollars you've been throwing away. Treated "waste" can become a source of valuable raw materials and water suitable for process and boiler feed uses. Graver equipment, backed by 45 years of experience and research, is specifically engineered to get such results for you.

Write for the following catalogues and articles:

WC-116.....Industrial Waste Treatment
WC-119.....Aeroflotor
T-122.....Some Economic Aspects of White Water Treatment in Pulp & Paper Mills
T-123.....Applications of Ion Exchange to Plating Plant Problems
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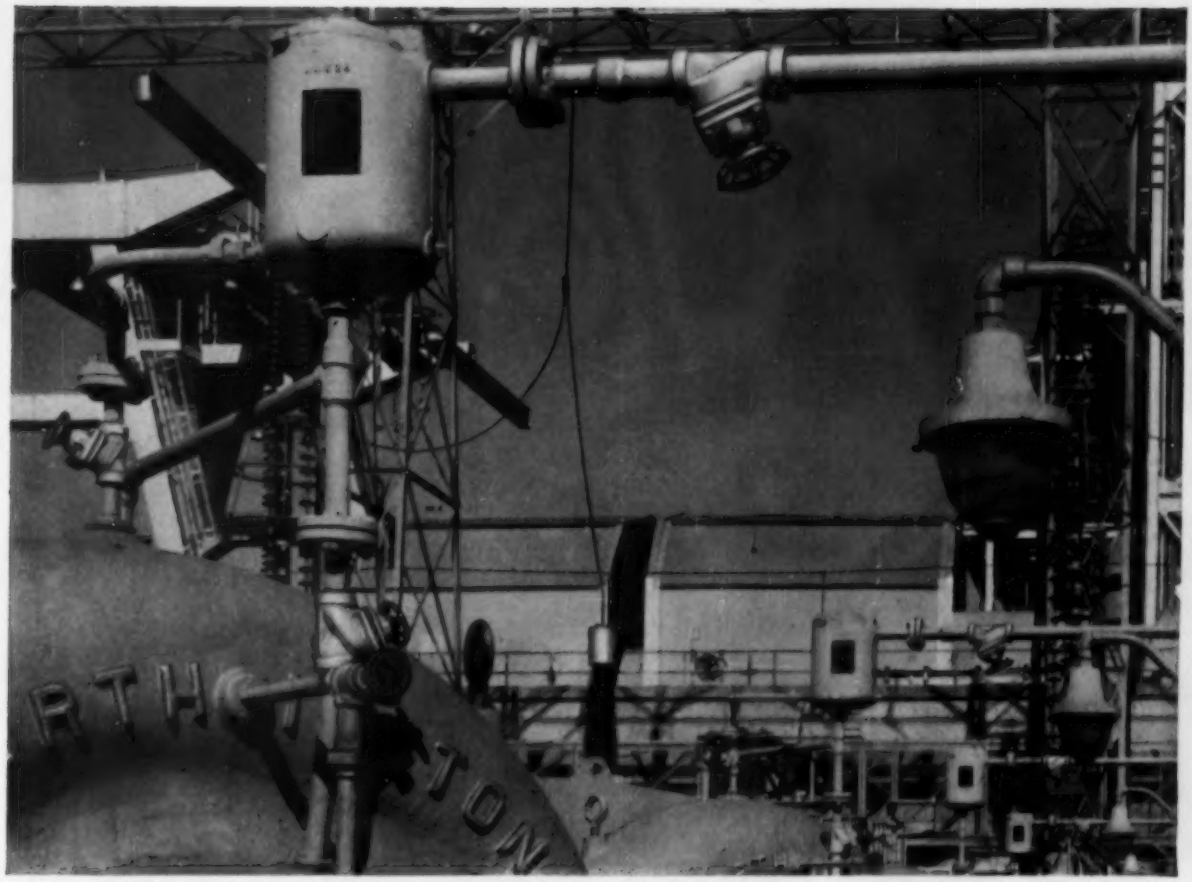

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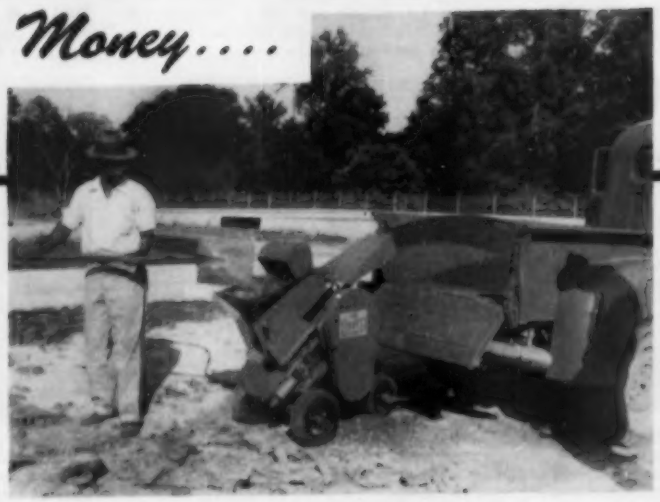

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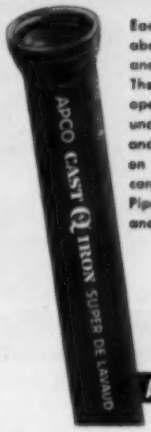

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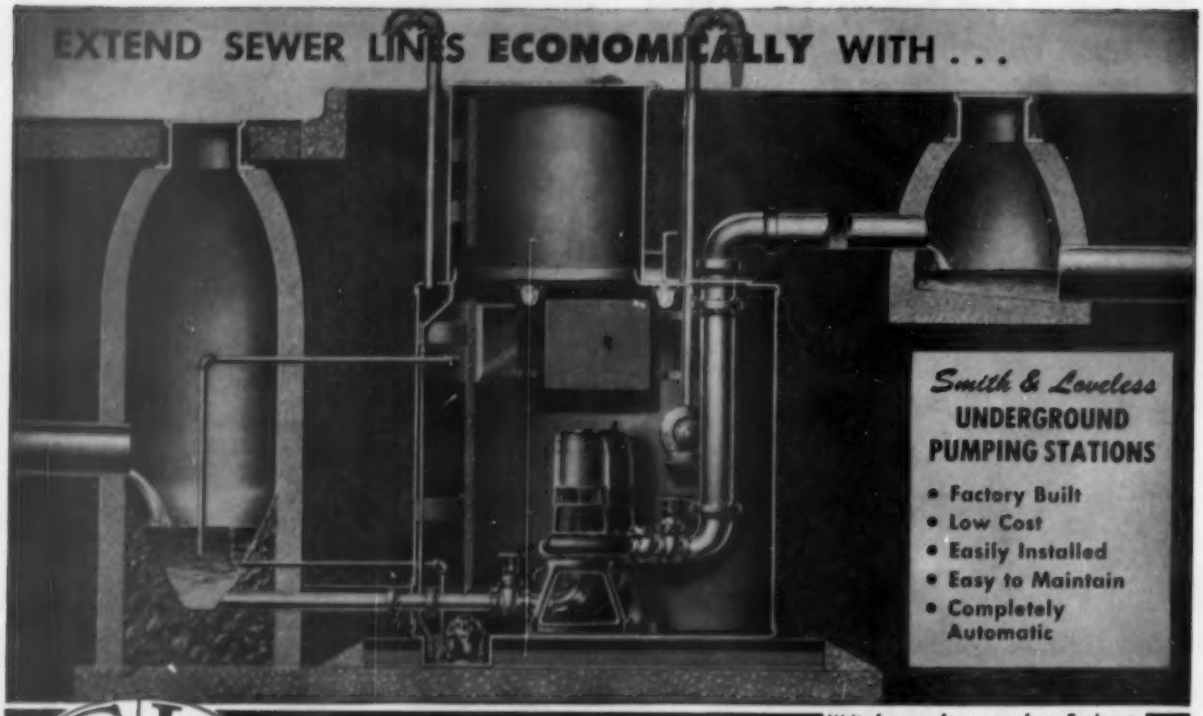

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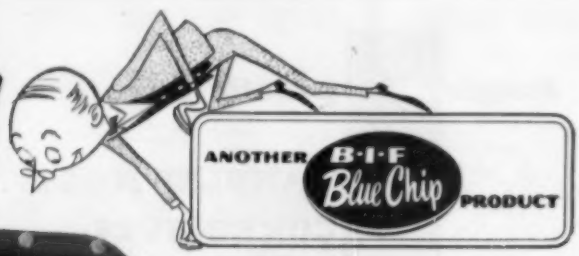

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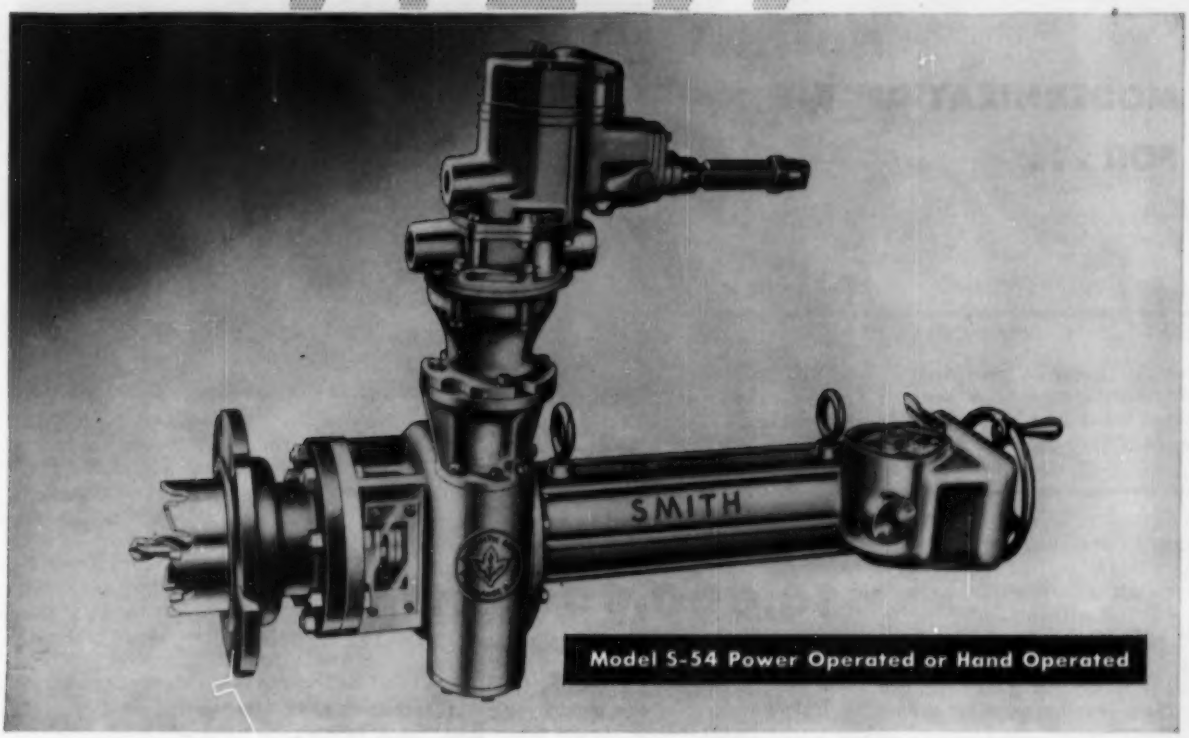

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WATER & SEWAGE WORKS

VOL. 102, NO. 4 • A Scranton Gillette Publication • APRIL, 1955

Survey of Vacuum Filtration for Disposal of Sewage Sludge

Operating trends and process costs during the years 1941 to 1953

by JAMES M. MORGAN and JAMES F. THOMSON

Mr. Morgan is Assoc. Prof. of Civil Engineering, Virginia Military Institute, Lexington, Va., and Mr. Thomson is Engineer, Whitman, Requardt and Assoc., Consulting Engrs., Baltimore, Md. Their paper comprised part of a seminar on STUDY OF SLUDGE DISPOSAL at Johns Hopkins Univ., Dept. of Sanitary Engineering.

THE removal of any undesirable end-product from any process usually is costly as well as troublesome. Removal and disposal of sludge, as an end-product of modern sewage treatment processes, is no exception. In essence, the enigma of sewage treatment is the disposal of ever-accumulating sludge.

The disposal methods employed during the period of modern sewage treatment practice have been many and varied. Before sludge can be disposed of conveniently and safely, in and near populated areas which are its source, it should be dried to a suitable moisture content. The need to dewater great amounts of excess sludge arose at large activated sludge treatment plants. The removal of water from sewage sludge on sludge drying beds had been practiced earlier—with varying results. This practice was considered successful after a highly dewatered cake was produced; often considerable time was required to attain that end.

The removal of moisture from sludge makes it possible to transport the dewatered sludge in containers that need not be water-tight. When the water content of the sludge has been reduced to about 60-75 per cent, sludge may be readily handled with shovel or fork, and is easy to spread or work.

By far the speediest method of mechanically dewatering sludge is to remove the bulk of water through some type of filtration. In the United States, the most successful approach has been the vacuum filtration process. Other countries, notably England, generally prefer the filter press. When mechanical methods became practical (during 1920-1930) sludge filtration became popular not only for dewatering activated sludge but also for raw and digested sludges, chemical precipitated sludges, and combinations of these sludges.

Vacuum Filtration Practices

In the practice of vacuum filtration, hollow metal drums of varying lengths and diameters are covered with cloth (or suitable filtering material), supported over compartments connected both to vacuum and pressure systems. The drums are designed to rotate slowly in troughs of "conditioned" sludge. Vacuum is automatically applied to the compartments as they enter the trough, and this causes some of the sludge to adhere to the filtering material. As the drum rotates, vacuum is continually applied (see Fig. 1) through almost a complete revolution, thus dewatering the sludge by suction (20-26 inches Hg). At the necessary stage of drum revolution, the vacuum is released and pressure is applied to help remove the resulting ¼-in. to ⅝-in. layer of filter cake. The cake falls or is scraped from the filtering material onto a conveyor belt for removal to plant storage grounds; or it is conveyed directly to a waiting vehicle for local or long-distance delivery.

Attempts to filter untreated sewage sludge invariably fail. An initial layer of colloidal sludge solids builds up on the filter cloth and reduces its filtering ability.[1] To overcome this operating difficulty, conditioning of sludge is the usual practice. In the United States, sludge conditioning is by chemical treatment; in England conditioning has been achieved either through the use of chemicals or by excessive heating[2] and, on a laboratory scale, by freezing.[3]

Moisture in the resulting sludge cake depends upon the amount and nature of the conditioner as well as upon the type of sludge treated.

Conditioning of Sewage Sludge

Conditioning[4] of sludges usually refers to preliminary mechanical treatment and to the addition of chemicals or other substances preparatory to dewatering. Methods of treatment in general use are classified as: (a) Digestion, (b) Elutriation, and (c) Concentration.

Digestion

Digestion of sewage sludge is not practiced at all plants employing vacuum filtration, although vacuum filtration of raw sludges is infrequent. Where raw sludges are to be filtered, Fisher[5] recommended that a thickening tank with a 2-day sludge capacity be furnished. He also indicated that

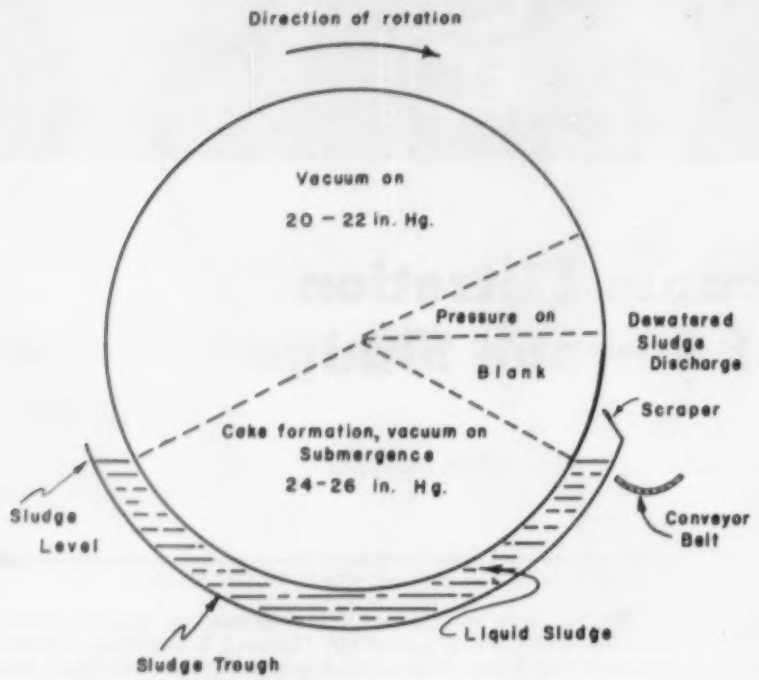
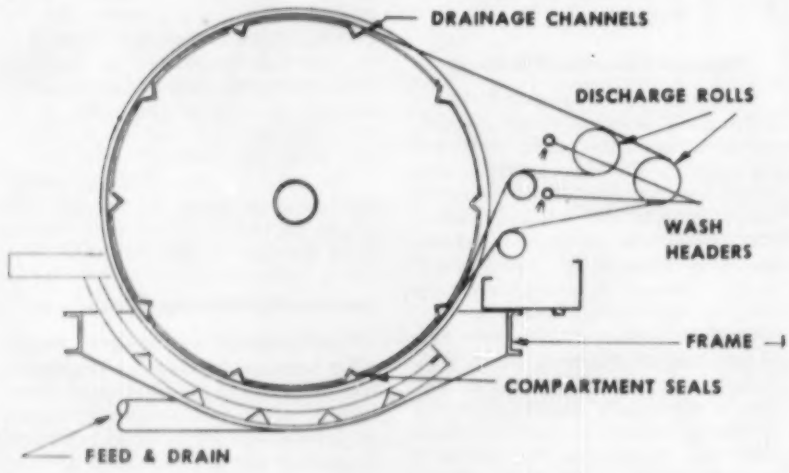


Fig. 1—BLANKET type of rotary vacuum filter for sewage sludge dewatering. This illustrates cycle of cake formation, vacuum application, and discharge.



Komline-Sanderson Eng. Corp.

Fig. 2—COILFILTER. Two layers of springs, lifted from the drum, are separated by discharge rolls and cake is discharged from upper layer.

sludge digested for only 20 days has better filtering qualities than one digested for a longer period. Our survey of sewage treatment plants in the United States shows that 21 plants practice sludge digestion at varying temperatures for periods of 30 to 90 days prior to filtration, and that the average digestion time is about 45 days for all plants reporting.

Elutriation

Elutriation is the process of "washing" sludge, using varying ratios of sludge to water. The process consists of running water and sludge into tanks, providing thorough mixing and a separation period of 2 to 6 hours, decanting the elutriate, and finally drawing off subsided sludge for further conditioning before filtration. Elutriation removes the amino-ammonia nitrogen[6] which interferes with sludge conditioning. This treatment is more effective with digested than with raw sludge. The elutriate usually is returned to primary settling units.

Experience at Washington, D. C., in a well designed and operated sewage treatment plant, has shown conclusively that elutriation has definite economic possibilities and is an acceptable conditioning process for filtration. The value of elutriation at this plant for the year 1941 was determined to be $11,015. In arriving at this value, construction costs, fixed charges, and patent right fees were included as were labor, materials, and cost of electric energy. This represented a 1.3c per capita savings in a population of 800,000. The savings actually resulted from a three-fold reduction in ferric chloride required for concentration. Fuhrman[7] concluded that, at this rate, the elutriation process would pay for itself within 4 to 5 years.

In 1941, Washington, D. C., was using a 1:3.8 ratio of sludge to water volume, with an average alkalinity decrease from 3,346 ppm in digested sludge, to 450 ppm in the elutriated sludge. In 1953, digested sludge was elutriated with Potomac River water at a ratio of 1:1.5, with the countercurrent method of washing employed. The alkalinity decrease in 1953 was the same as for a single wash at the ratio of 1:3.6.

Springfield, Mass., reported the highest elutriation ratio in 1953: a sludge to water volume of 1:4.5. Washington, D. C., already mentioned, had the lowest ratio.

Concentration

Substances that have been added to sludge to condition or concentrate it (either with or without elutriation and digestion) include the following: sulfuric acid, sulfur dioxide, alum, bone ash, peat, ground garbage, paper pulp, ashes, and clay.[8] The most universally employed materials are ferric chloride, lime, and ferrous sulfate.

In the operating year 1951-1952, Buffalo, N. Y., substituted 16 to 20 per

TABLE 1

Comparison of Data on Sludge Dewatering at Six U. S. Cities Reported for Years 1941 to 1953

	Washington, D. C.			Minneapolis-St. Paul			Buffalo, N. Y.		
	1941	1951	1953	1941	1951	1953	1941	1951	1953
Approximate Pop., mil.	0.8	0.92	1.04	.805		.907	.6	.6	.6
Sludge Dewatering, type	Prim. Dig. 30 days			Raw Primary, Conc. Only			Prim. Dig. 60 days		
Sludge Dewatering, dry tons	6,870		6,536	35,993		32,529	10,051		7,369
Total sewage flow, mg	39,568		59,843	39,286		45,706	51,262		49,976
Sewage susp. solids, ppm	180		207	315		256	168		174
Chemical Dosage, % dry sludge									
$FeCl_3$	3.18	3.6	4.0	1.53	0.98*	1.22*	2.93	2.85	2.19**
CaO				3.77	2.75	3.03	11.21	11.71	15.86
$FeSO_4$									
Chemical Costs, cents per capita	1.06		1.6	4.15		4.9	3.06		3.45
Chemical Costs, $/ton									
$FeCl_3$	39.00		64.00	38.21			31.80		80.00**
CaO									70.00
$FeSO_4$ (No Data)									
Filter Operations									
Number filters	4	4	4	6		8	3	3	3
Hours/year	4,705		3,822			38,919	6,320		5,893
Days/year	220		215			351	306		270
Filter cloth	Wool		90% wool-10% nylon	CF***		CF	CF		CF
Washing schedule	2 to 4 times per day			Cont.		Ea. Hour		Varies	
Economic cloth life (hours)	600	700	1,000	356		489	211		159
Cake yield, lb./sq. ft./hr.	5.9	6.8	6.8	58.8		65.3	6.77	7.81	5.00
Volatile matter in cake, %	44.4		45.0	3.82	2.98	3.0	42.9		55.9

* $FeSO_4$ used since June 1947, here expressed in terms of equivalent $FeCl_3$
** Aluminum chloride
*** Canton flannel

	Hartford, Connecticut			Annapolis, Md.			San Francisco, Cal.*		
	1941	1951	1953	1941	1951	1953	1941	1951	1953
Approximate Pop., mil.	.15	.228	.238	.015	.025	.028	.145	.180	.190
Sludge Dewatering, type	Prim. Dig. 30 days			Prim. Dig. 40-50 days			Prim. Dig. 60-90 days		
Sludge Dewatering, dry tons	1,296	3,763	3,010	173	342	252	888	3,570	3,005
Total sewage flow, mg	5,200	7,570	7,786		1,184	1,381	2,941	4,336	4,058
Sewage susp. solids, ppm	160	174	171		70	90	254	290	249
Chemical Dosage, % dry sludge									
$FeCl_3$	2.23	2.01	1.79		2.3	2.5	4.3	2.59	3.08
CaO									
$FeSO_4$				2.86					
Chemical Costs, cents per capita	1.72	2.45	1.59	0.71				1.00	1.10
Chemical Costs, $/ton									
$FeCl_3$	71.40		110.20				60.00	66.00	66.00
CaO									
$FeSO_4$ (No data)									
Filter Operations									
Number filters	2	2	2	1	1	1	1	2	4
Hours/year	994	1,110	891	710	588	362	1,682		1,362
Days/year	156	95	74	145	101	91	197		193
Filter cloth	Wool	Wool	Wool	Wool	Wool	Wool	Wool		Wool
Washing schedule		Once/run			Daily	Daily		3 times per day	
Economic cloth life (hours)	600	400	600	142	350	400	900	500	500
Cake yield, lb./sq. ft./hr.	7.5	6.5	6.33	7.5	5.1	7.9	5.4	5.0	5.0
Volatile matter in cake, %	39.8	41.5	50.0						58.6

* Richmond-Sunset Plant
1941 data from Genter, A. L., Transactions, ASCE, Vol. 72, No. 2, Part 3 (1945), pp. 246-247

Fig. 3—BLANKET type vacuum filters operating in one of Chicago's sewage treatment plants. There are 98 units installed.

cent aluminum chloride for 40 per cent anhydrous ferric chloride. Prior to adoption, the suitability of aluminum chloride was investigated experimentally. An industrial waste survey revealed an aluminum chloride conditioner to be present in the liquid discharge from a local chemical concern. At the same sewage treatment plant, a change was recently effected in adapting to sludge conditioning a waste lime slurry from an acetylene manufacturing plant. The slurry contains 20 per cent available CaO and the total solids range from 30 to 35 per cent. Pebble lime, containing approximately 90 per cent available CaO, is used whenever the slurry supply is short. Some of the items mentioned by Babbitt[8] may be employed in a few plants today on a modified scale.

The time of concentration required in treating various sludges depends upon the amount and combination of chemicals added, as well as upon the mixing rate employed. In practice, mixing times from 4 to 20 minutes are common.

Table 1, among other items, indicates the concentration of conditioning chemicals in use and results accomplished. The cities listed were selected on the basis of having available 1941 operating data. The authors consider that they offer an average cross-section of operating results.

Based on data from these cities, it appears that chemical dosages have not changed drastically in 10 or 12 years, though the trend appears to be downward. The suspended solids content of sewage has remained fairly constant, while the percentage volatile matter in sludge cake has moved slightly upwards. Cake yield from the filters has remained steady, and the yields do not necessarily become large with increased chemical dosage.

To indicate the flexibility of a large vacuum filter installation, the following example is included. In 1947, the Minneapolis-St. Paul sewage treatment plant was forced to change to ferric sulfate as a conditioner, since no bids were received on ferric chloride.[9] During the first five months of 1947, a dose of 0.91 per cent ferric chloride and 2.53 per cent lime (CaO) was employed. Table 2 shows the experience thereafter. These data illustrate how improvement in handling and feeding, coupled with careful operation, can maintain low materials usage, and therefore costs—even when sludge conditioners other than those originally specified must be

TABLE 2

Change in Conditioning Chemicals
Minneapolis-St. Paul

	Chemicals, Per Cent of Dry Sludge Solids		
	Ferric Chloride	Lime (CaO)	Volatile Organic, %
1942-1946 average	1.10	3.06	65.2
January-May 1947	0.91	2.53	
	$FeSO_4$ in terms of equivalent $FeCl_3$ for comparison		
June-December 1947	1.52	4.45	
1948	1.23	3.17	
1949	0.94	2.95	69.6
1950	0.98	2.95	69.3
1951	0.98	2.75	
1952	1.22	3.02	65.3

Komline-Sanderson Eng. Corp.

Fig. 4—COILFILTER type vacuum filters installed in York, Pa., sewage treatment plant for dewatering elutriated digested sludge.

used.

Raw sludge is easy to condition with low chemical dosages prior to filtration in the Twin Cities plant because: (1) the sludge has a relatively low volatile and high ash content; (2) a high concentration of solids is present, and (3) the water has a low alkalinity. Solids are unusually high at Minneapolis-St. Paul on a per capita basis.[10]

However, according to plant personnel, the quality of recent sludge appears to be deteriorating.[11] An increasing grease content in the sludge (from a low of 11.6 per cent in 1942 to a high of 20.1 per cent in 1952), and a decrease in smooth flowing and filtration qualities, are attributed to: (1) rapidly increasing use of detergents, (2) gradual increase in the use of garbage grinders, (3) increase of 19 per cent in per capita meat consumption over pre-World War II standards, with accompanying higher grease content, (4) delayed plant arrival of sewage solids due to an increase in size of sewer collecting system, and (5) growth of local soybean, linseed, and vegetable oil industry, as well as the grease discharged from a nearby ordnance plant.

TABLE 3

Sludge Dewatering by Vacuum Filtration
Cost Per Dry Ton—1953

	Washington, D. C.	Buffalo, New York	Columbus, Ohio	San Diego, California	Duluth, Minnesota
Approximate Population	1,040,000	600,000	500,000	450,000	80,000
Sludge Production, dry tons	6,536	7,369	6,360	2,327	194
Chemicals					
Ferric chloride	$3.10		$3.79	$4.58	$1.67
Lime		$1.62	2.54		1.38
Aluminum chloride		1.20			
Labor	3.91	6.81	5.32	7.44	5.75
Filter Cloth	0.14	0.25	0.47	0.36	0.34
Power	0.24	1.56	0.07	0.37	1.25
Total Unit Cost	7.39	11.44	12.19	12.75	10.39
Revenue from sale of sludge	*			6.65	4.80
Net unit cost	$7.39	$11.44	$12.39	$6.10	$5.59

* Negligible

Vacuum Filtration Costs

For exact comparison, costs are always difficult to cite accurately, since conditions and "bookkeeping" vary from community to community. Therefore, the costs, when they appear, should serve as indicative only. In Table 3 the unit cost breakdown, of sludge dewatering by vacuum filtration, shows that there is one item in common in most cities; i.e., labor charges account for the greater part of the filtration cost. Milwaukee, which spends by far the highest amount ($37.53 per dry ton) to produce a saleable item, also collects the largest return ($33.64 per dry ton) from the sale of its organic fertilizer, *Milorganite*. In 1953, approximately 69,000 dry tons of sludge were produced at a net cost of $3.89 per ton by this city; all of the sludge was sold directly as a fertilizer. Costs quoted are only for the sludge dewatering plant.

Revenue at Duluth, Minn., and San Diego, Calif., considerably reduces

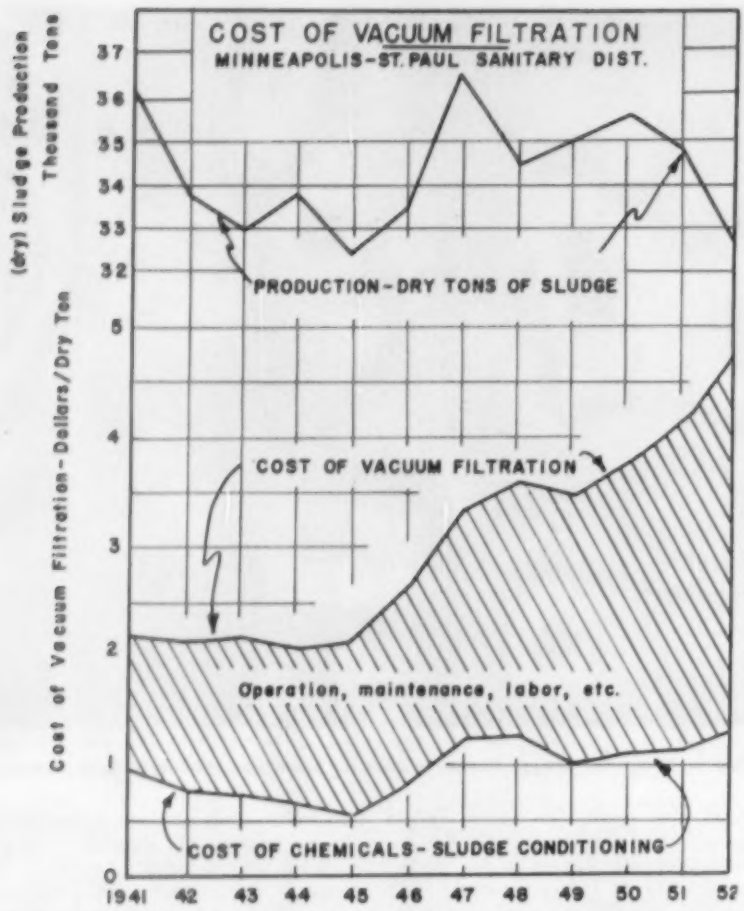


Fig. 5—GRAPHICAL comparison of data, 1941 to 1953, for vacuum filtration of sewage sludge at Minneapolis-St. Paul.

the net unit cost of vacuum filtration. It is also interesting to note that total unit costs per ton, of dry sludge solids, excluding capital investment, were approximately the same for Buffalo, Columbus, and San Diego, all of which have approximately a one-half million population.

Table 1 gives an indication of essential items in vacuum filtration practices in the United States. It is interesting to note that in all plants practicing elutriation, the chemical costs per capita were lower than Minneapolis-St. Paul; in the latter city elutriation is not practiced—the raw primary sludge is concentrated only. Also, the "medium-size" cities enjoy as favorable as per capita outlay for chemical costs as do the larger metropolitan areas.

English experience during 1949 at the Halifax Sewage Treatment Plant, where sludge is conditioned by heating to approximately 360° F., showed the cost of treatment per ton of dry solids to be 46 s. 10 d. ($6.56).[12] The cake was not filtered, but was "squeezed" in a Johnson Press.

Figure 5 illustrates a 12 year record of vacuum filtration costs at the Minneapolis-St. Paul Sewage Treatment plant.[13] During that period, sludge production varied from a minimum of 32,482 dry tons (in 1945) to a maximum of 36,663 dry tons (in 1947). Using 1941, the last pre-World War II year as a base, the unit cost of chemicals per dry ton for sludge conditioning rose from $0.93 to $1.37 in 1952, an increase of 47 per cent. During the same period the cost of operation, maintenance, and labor rose 178 per cent. Each year after 1941 showed a steady rise in operation, maintenance, and labor costs, with only a slight evidence of a drop in 1944. This is perhaps indicative of most cost trends in the United States during the years considered.

Operation of Vacuum Filters

As far as is known, filter operations are not continuous in any of the large or small United States sewage plants employing vacuum filtration. Approximately 5 to 8 hours of filter runs daily will dewater the collected sludge, and this rate is usually maintained for 5 or 6 working days per week. Total annual filter runs from 900 to 2100 hours were reported. Runs of greater length are not common. All cities listed in Table 1 use either wool or Canton Flannel filter cloths (or a combination of wool and nylon) supported over the drum on wire meshes.

Liberty, N. Y., (not included in table) employs a coiled spring unit (Komline-Sanderson) with two drying drums, each 8 ft. in diameter and 6 ft. long. The coils lay down in overlapping positions giving two complete layers. The drum rotates with vacuum applied 50 per cent of the time from dead center bottom to dead center top. In this position the spring acts as a filtering device and later, after reaching dead center top, the springs are stripped mechanically from the filter and flexed. Stainless steel fingers strip the cake from the coils, complete cleaning being aided by the flexing operation which is con-

TABLE 4
Per Capita Sludge Production at Seven U. S. Cities

City	Population* in millions		Sludge product'n, dry tons		Sludge product'n, pounds per capita		Percent Change Per capita	
	1941	1953	1941	1949-53 Ave.	1941	1949-53 Ave.	Pop.	Sludge Prod.
Buffalo, N. Y.	0.6	0.6	10,051	8,462	33.5	28.2	0	— 15.8
Minn. - St. Paul, Minn.	0.8	0.9	35,993	34,527	89.5	81.2	+ 12.7	— 9.3
Washington, D. C.	0.8	1.0	6,870	6,506	17.1	14.1	+ 30.0	— 17.5
Annapolis, Md.	0.025	0.028	173	472	13.8	36.8	+ 12.0	+ 166.3
Hartford, Conn.	0.150	0.238	1,296	3,668	17.3	32.1	+ 58.8	+ 186.0
San Francisco, Cal.**	0.145	0.190	888	3,374	12.3	37.2	+ 31.0	+ 202.0
Springfield, Mass.	0.130	0.140	946	1,875	14.6	26.5	+ 7.7	+ 81.5

Note: 1941 information from Genter, A. L., Transactions, A.S.C.E., 1945, Vol. 72, No. 2, Part 3, pp. 246-247

* Approximate sewered population

** Richmond-Sunset Plant

tinuous. Liberty is a summer resort and the summer population doubles the full-time number of winter residents from about 7,000 to 15,000. The unit has been satisfactory to date.[14]

During 1941, the vacuum filters in Washington, D. C. were washed for 30 to 45 minutes after each operating period to remove particulate matter that had a tendency to blind the cloth. On a regular basis, the cloths were washed for 24 hours in a 1 per cent oxalic acid solution. This operation increased the service of wool cloths from 528 to 682 hours on the average, or about 30 per cent. On the basis of a first cost of $120 per filter cloth, the hourly cost of operation was reduced from $0.23 to $0.18.[15]

In 1953, Washington installed 90 per cent wool—10 per cent nylon filter cloths; these filters were washed from 2 to 4 times each operating day. During 1953 all four cloths were replaced, but after an average service of about 1100 hours. Filter cloth cost per dry ton during the year averaged $0.14. Two of the four replacements were made with 100 per cent nylon cloths. Results of new cloth trials are not yet available.

Each vacuum filtration plant has its own schedule for washing filters, and uses varying pressures of water. The range of filter washing in 1953 was reported to be from an hourly basis to every 14 hours of operation.

Hourly vacuum filter washing has shown promise in Milwaukee. The filter washing times tested have varied from once every 24 hours to continuously. Continuous spray washing with plant effluent at 65 to 70 psi pressure did not prove desirable. Hourly washing at 30 to 50 psi helped maintain a cleaner filter media. The following data list the complete washing cycle practiced in Milwaukee:[16]

Plant started	Washing Time	Pressure
1938	Every 24 hours	(?)
1942	Every 8 hours	(?)
1947	Continuously	65 - 70 p.s.i.
	Every hour	30 - 50 p.s.i.

Our survey showed that filter cloth expenses varied from about 2 to 4 per cent of the unit cost of vacuum filtration on a dry ton basis. When rates of filtration are high, filter cloth costs increase, as do the chemicals required to effect proper filtering.

Municipal Sludge Production

According to the most recent information, a U. S. population of approximately 92 million contributes sanitary sewage to sewers. Of this number some 62 per cent, or 57 million, sends domestic waste to systems that will eventually reach sewage treatment plants of one description or another.[17]

Questionnaires were sent during 1953 to 15 cities throughout the United States with a total population of 4,907,000. Replies indicated that about 78,000 tons per year of dry sludge were produced in those cities. This is equivalent to a contribution of 32 pounds of dry sludge per capita per year. These figures do not include Milwaukee, since the sludge production from that city is abnormally high. The population of cities included in the total mentioned ranged from 28,000 to slightly more than 1,000,000.

Table 4 indicates that for cities over one-half million in population, the sludge production on a per capita basis has declined since 1941. In smaller cities, with one-quarter million or less population, the reverse is true. These figures are from plants that employ vacuum filtration as a method of sludge dewatering, and do not necessarily represent a per capita trend in all American cities.

A considerable quantity of sludge that is dewatered by filtration eventually finds ultimate use as land fertilizer, either as a commercial fertilizer filler or as a lawn dressing. The return from sludge sold for these purposes seldom cancels operating charges necessary to prepare the end-product for sale.

Chemical Composition of Sludge

The composition of digested sewage sludge varies from place to place. Analyses of many hundred pre-1945 samples collected throughout the United States show the following percentage ranges and averages:

	Range	Average
Ash	36 - 58	49
Volatile	42 - 64	51
Nitrogen as N	1 - 4.5	2.2
Phosphorous as P_2O_5	0.6 - 5.7	1.5
Potash as K_2O	0.3 - 1.6	0.7
Grease and Fats	3 - 17	8

Ten vacuum filtration plants in the U. S. have furnished complete or partial chemical analyses for the 1953 operating year. Two of the plants, Dearborn and Milwaukee, do not employ digestion preliminary to vacuum filtration.

Table 5 shows ranges as well as arithmetic and weighted averages of chemical analyses for 1953. Since the values submitted for Milwaukee covered a period of seven years (1945-53), figures for that city were included in two calculation but omitted from the last. It is interesting that the ash and volatile arithmetic averages shown above and in Table 5 coincide.

The 10-plant arithmetic and weighted averages show that 1953 sludge, for the plants reporting, has a greater nitrogen, phosphoric acid, and grease content than the pre-1945 values. On the other hand, potash in Rudolfs' averages is greater than twice the 1953 value.

Weighted values, without the 1947-53 Milwaukee determinations, show a completely different set of figures when compared with pre-1945 or 1953 values. Volatile content is high, while nitrogen, phosphoric acid, and potash fall considerably below the pre-1945 and 1953 averages.

Units Not in Use

In addition to the statistical information received, the following comments were reported from five widely separated areas:

TABLE 5
Constituents of Vacuum Filtered Sludge—1953

Analyses Reported as Percent on Dry Basis

Determination	Range[1] Minimum	Range[1] Maximum	Averages Arithmetic	Averages Weighted[2]	Averages Weighted, without Milwaukee (1947-52)
Ash	25.6[a]	70.0[b]	49.0	37.1	33.9
Volatile	30.0[b]	74.4[a]	51.0	62.9	66.1[a]
Nitrogen as N	1.7[b]	6.34[a]	3.49	3.14	1.90
Total Phosphoric Acid as P_2O_5	1.2[a]	3.86[b]	2.42	2.52	1.83
Potash as K_2O	0.09[c]	0.57[d]	0.30	0.42	0.35
Grease	7.0[e]	36.2[e]	11.7	12.4	11.4

1. Includes: Aurora, Ill., Buffalo, N. Y., Dearborn, Mich., Duluth, Minn., Hartford, Conn., Milwaukee, Wis., Richmond-Sunset Plant, San Francisco, Cal., San Diego, Cal., Washington, D. C., and Worcester, Mass. Combined approximate sewered population = 4,113,000.
2. Population times constituent for each city divided by total population reporting.
a = Milwaukee, b = Hartford, c = Buffalo, d = San Diego, e = Washington.

Marion, Ind.: "One filter that is not used" was the reply to the question concerning the number of filters in operation. "All sludge is hauled in liquid form by tank trucks and sprayed on farm land, the sludge being disposed of by sale as a soil conditioner."

Oklahoma City, Okla.: "No filters used at the Northside Sewage Treatment Plant since 1950."

Pasadena, Calif.: "The disposal of sludge by filtration and drying was discontinued in 1942, since which time the sludge has been disposed of by contract through the facilities of the Los Angeles County Sanitation District." In 1948, the City of Pasadena discontinued the operation of its sewage treatment plant entirely.

Wisconsin Rapids, Wis.: "The use of vacuum filtration was discontinued about 10 years ago. We now use open sludge beds."

Rock Island, Ill.: "At Rock Island we have two filters, size 4-ft. x 6-ft. They are not used. These sludge filters have been standing still for the last ten years. Then engineer of the sewage treatment plant in 1942 said it cost to much to operate the filters . . ."

Summary of Survey Data

The disposal of constantly-accumulating sludge in sewage treatment processes is an essential and costly operation. Vacuum filtration is a rapid method of dewatering sludge to facilitate disposal. Digestion, elutriation, and concentration, singly or in conjunction, usually precede filtration.

The average sludge digestion time used in U. S. plants employing vacuum filtration from 1941 to 1953 was about 45 days, with a range of 30 to 90 days. Elutriation, less widely used than digestion, reduces the amount of chemicals required for concentration, and lowers the alkalinity of digested sludge. A counter-current method of washing sludge has reduced the volume of water necessary to produce a specific alkalinity reduction.

Several chemicals, notably ferric chloride and lime, are widely used as conditioners. Two large sewage treatment plants have ceased using ferric chloride: a northeastern plant used aluminum chloride which was discovered in a waste discharged from a local chemical concern, and substituted lime slurry from a nearby acetylene plant; a mid-western sewage plant adopted ferric sulfate, used in conjunction with lime, when no bids were received on a proposal to furnish ferric chloride. Flexibility of changeover from original specified materials to other chemicals is noteworthy. The same mid-western plant is experiencing a definite change in sludge quality because of modern consumer and homeowner habits.

Revenue from the sale of sewage sludge as commercial fertilizer or lawn dressing seldom equals vacuum filtration operation and maintenance costs. Excluding fixed charges, total unit cost in 1953 for dewatering sludge by vacuum filtration varied from $7.00 to $13.00 per ton of dry solids, with revenue from the sale of sludge infrequently reducing these figures. One English experience of 1949 approaches the lower cost limit.

In comparing data from six cities, the per capita chemical costs for sludge conditioning were lower where elutriation was practiced. Chemical costs have risen since 1941. A breakdown of individual items shows that labor accounts for the largest expenditure in vacuum filtration on a dry ton basis; an increase of about 180 per cent in labor, maintenance, and operation costs was reported in one instance.

Annual filter operating periods from 900 to 2100 hours have been reported throughout the period under discussion. The average life of filter cloths appears to be 400-600 hours during this period. Of the plants reported, only one has experimented with any new filter media; i.e., a 90 per cent wool—10 per cent nylon cloth, which was in successful operation in 1953 for about 1100 hours per cloth. The 100 per cent nylon cloths now are being used experimentally. A coil spring filter, of indefinite life, is mentioned. Filter washing, using different water pressures, has varied from continuously to every 24 hours throughout the operating period.

Annual sludge production data reported by 15 cities, varying in size from 28,000 to 1,000,000, and having a combined population just under five million, averaged 32 lb. per capita on a dry basis, during the year 1953. This production compares with 42.4 lb. per capita production during 1941 based on data reported by seven cities having a combined population of 2.5 million. Average sludge production in the same seven cities during the period 1949-53, with population increased to three million, had dropped to 38 lb. per capita per year. A percentage decrease in sludge production was noted in cities over one-half million in size; cities one-quarter million or less showed increased per capita sludge production.

An arithmetic average of 1953 sewage sludge analyses, representing a population of approximately four and one-half million persons, indicates that sludge is becoming richer in chemical content, but has a higher grease content, when compared to pre-1945 sludge constituents.

Acknowledgements

Many sewage treatment plant superintendents and other municipal officials contributed to making this study possible; the names are too numerous to list here, but their efforts are appreciated. Special acknowledgement is due to Dr. Abel Wolman and to Dr. John C. Geyer, of the Department of Sanitary Engineering, Johns Hopkins University, for their assistance and many suggestions during the course of the study.

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COMMENTARY

Our Dwindling Clean Water Supply

How water shortages affect our municipal and industrial expansion

by RALPH E. FUHRMAN

Mr. Fuhrman, Executive-Secretary of the F.S.&I.W.A., Champaign, Ill., was previously Deputy Director of Sanitary Engineering, Washington, D. C. His paper reviews many aspects of present water supply problems. It was presented at the Third Southern Municipal and Industrial Waste Conference at Raleigh, N. C.

TO ONE easily disturbed, the thought of a dwindling water supply may easily lead to a cry of "wolf." While such a cry may seem almost necessary in some cases to arouse the citizenry, we may be thankful that such tactics are not often resorted to, since they accomplish very little toward the solution of an engineering problem. A more rational approach prevailing among engineers faced with the solution of a difficult water supply problem would include a thorough analysis of the quantity and quality of available supplies, along with the cost of the most advantageous solution.

Water and Our Economy

An article in the March 1954 issue of *Fortune* magazine reviews dramatically the national water situation, particularly as it relates to industrial needs. Francis Bello has prepared this audit of water resources.

To maintain the average man in the United States requires about fifteen hundred tons of fresh water per year. Of all other materials—food, fuel, metals, plastics, lumber, sand and gravel—a man requires only about eighteen tons. About one-third of this total amount of water is lost in plant transpiration and evaporation, while the remainder is returned in volume, if not in cleanliness, to the nation's streams. The total amount of water, fifteen hundred tons per year per capita, does not include the volume (seven times as great) used in the generation of hydroelectric power.

Water is unquestionably the cheapest commodity sold by quantitative measure. If necessary to demonstrate this to yourself, try to lift a penny's worth of it sometime. Before such an effort, however, I suggest a thorough physical examination and perhaps a mental examination by competent members of the medical profession. Even at the substantial rate of twenty cents per thousand gallons, your "penny's worth" would weigh over 400 pounds.

Division of Water Industry Costs

In our billion-dollar-a-day national economy, total costs of water run much less than one per cent, with the city dweller's share approximately one-seventh of one per cent or $500 million per year. Agriculture's share of the cost is less than half of the city dweller's. The remainder of our $3 billion national water bill is borne by industry.

Another measure of the size of the water industry is the huge investment in water supply and distribution facilities. At the present time this amounts to about forty billion dollars, of which $7.5 billion represents public supplies. The low ratio between annual income and the investment necessary to produce it, has been cited as one reason for the reduction in privately-owned water systems and the increase in publicly-owned systems.

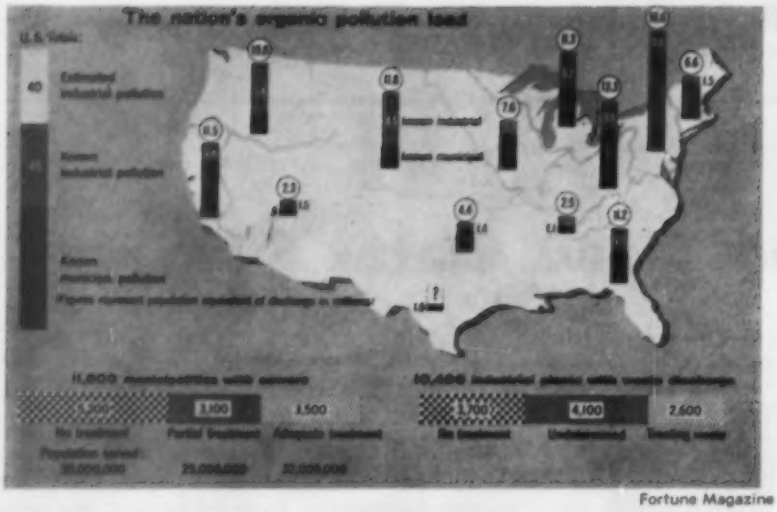
On a national scale there is no need to feel that the United States is running out of water. At the same time it must be appreciated that the seventeen western states are using about seventy per cent of all the water they may expect to develop at reasonable cost. Arizona is using more water than is available within its borders. California has considered bringing water from the Pacific northwest to meet future demands. Texas is considering bringing water from the Mississippi.

At the present time, in many parts of the United States, it is necessary to practice conservation measures that are completely unknown in other parts. The natural emphasis placed on water shortages, like the New York City case of 1950, may lead to hasty conclusions if applied to other places without thorough analysis.

Water Supply—National Problems

In very recent years there have been several significant efforts at portraying the overall problem of water supply for the United States on a national basis. In 1950 the President's Water Resources Policy Commission issued its voluminous report entitled "A Water Policy for the American People." In June 1952 the President's Materials Policy Commission studied the materials problems of the United States and their relation to the free and friendly nations of the world. Such a study necessarily included a consideration of water resources. These primary studies, supported by more detailed investigations and reports by the U. S. Geological Survey and the U. S. Public Health Service, give a plentiful supply of information on this subject.

The mid-century conference on resources for the future held in Washington during December, 1953, included one section devoted to water resource problems. All of these reports should be required reading for industrialists and engineers who have or ever may have water supply problems. The reports present data like those just stated, but also point out that information is incomplete, par-



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POLLUTION load of municipalities and industries, based on oxygen depletion.

ticularly as to non-consumptive water use. Even with this shortcoming, we must accept them as the best available until the future brings additional information.

President Truman's Materials Policy Commission concluded that by 1975 the United States may be using as much as ninety per cent of all water than can be developed at reasonable cost. Apparently this conclusion did not differentiate between the consumptive and nonconsumptive uses of water. The ordinary municipal and industrial use of water is nonconsumptive, that is, substantially equal volumes are discharged to surface streams after use.

On the contrary, irrigation returns to streams or groundwater only about one-third of the volume used; while the remainder is lost through evaporation and transpiration. The Policy Commission estimated that the 1975 water demand would be nearly double the 1950 water demand. The increase in irrigation expected for the same period is substantially less. Much of the increase is expected to come from the cooling water requirements of electric generating stations; such stations are expected to quadruple in capacity during the 25-year period. Fortunately, this use does not diminish the water supply; but it does return the water to the stream at an elevated temperature. Though this factor cannot be considered desirable, we are far better off to have temporarily warm water than to have no water.

Regional Aspects of Water Supply

As described in the *Fortune* article, there is a great difference between the demand and supply pictures when the seventeen western states and the thirty-one eastern states are compared. For this comparison, the Louisiana to Minnesota column of states and all those eastward are differentiated from the western states. The average annual precipitation on the whole United States is 4,300 bgd (billion gallons daily). The average runoff and percolation is 350 bgd divided between the 17 western states, and 900 bgd divided between the thirty-one eastern states..

About two-thirds of the western states' run-off is, unfortunately, concentrated in the Pacific Northwest—a long way from arid southern California. Based on a 1950 U. S. Geological Survey Study, the seventeen western states use about 77 bgd for irrigation. This is nearly equal to the East's total use of 80 bgd. Of the 350 bgd in the seventeen western states 120 bgd, or thirty-four per cent, are considered to be economically available. Since 50 bgd are used consumptively, and 35 bgd are used nonconsumptively, an additional 35 bgd could still be developed at a reasonable cost.

In the 31 eastern states, a somewhat brighter picture is presented. Of the 900 bgd total runoff, 225 bgd or 25 per cent are considered potentially available with 80 bgd as the present use. Of this, only 7 bgd are used consumptively. As the result, the remaining 73 bgd are potentially available if a combination of hydrowaste treatment, with or without natural purification, will allow further use of this water. The increased potential of new supplies available is 155 bgd in the eastern states.

Increase in Water Needs

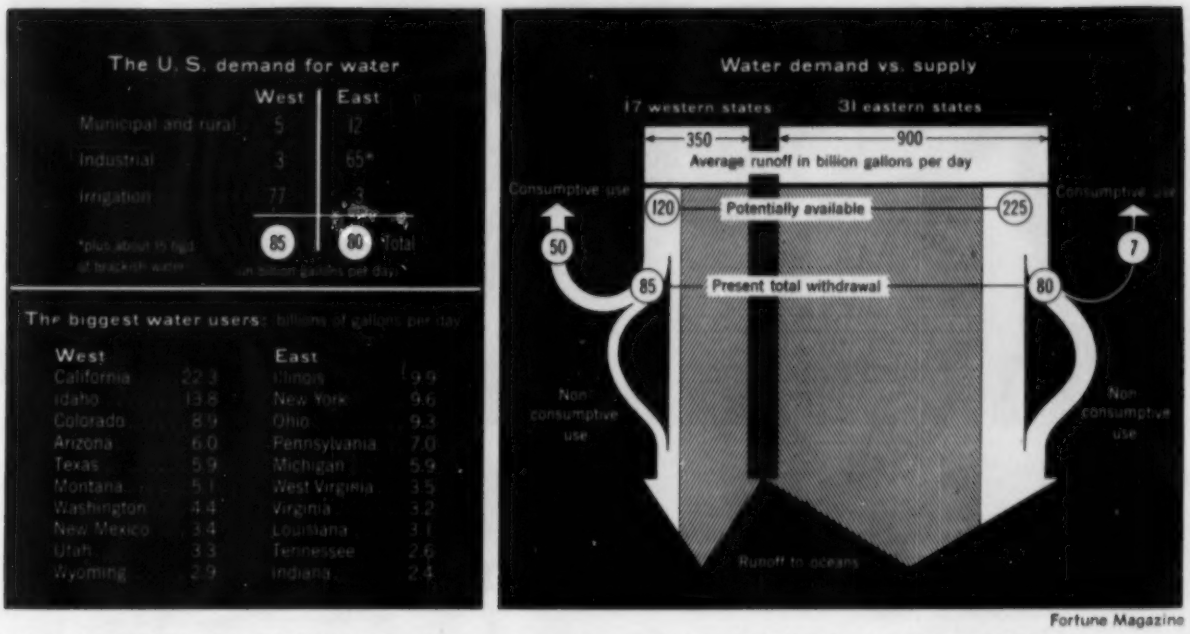
In the twentieth century the withdrawal of water in the United States has about doubled on the average of every twenty-five years. We should have a wholesome concern about our clean water supply. The withdrawal of water is unlikely to double in all parts of the country by 1975, but it appears that increasing per capita consumption to support our constantly rising standard of living will impose this overall demand on water supplies. We may do well to inquire into the possible methods of meeting such a situation. In the parts of our country where water resources can supply this additional withdrawal there is no problem. In other parts of the country it appears that more and more future water needs must be solved by recirculation, reclamation, or, in general, the better use of existing supplies.

The West must decide whether it wishes to use its water resources for the comparatively low value of products produced by irrigation or whether it will prefer to use its water in the production of goods with greater dollar value per gallon of water used. The East must make decisions as to the extent that cities and industries will be allowed to continue the wholesale defilement of streams by pollution.

Methods of Water Conservation

Reclamation of used water is generally practiced only where reclamation is cheaper than the cost of additional supply. One of the best examples of this practice has been the reclamation of Baltimore sewage plant effluent by the Bethlehem Steel Company for use in steel production at the Sparrows Point Mill. The steel mill adopted this practice as the result of an extreme ground water shortage caused by over-pumping in the area. While present use amounts to about 60 mgd (million gallons daily), plans are being made to reclaim the entire volume of treated sewage of the City of Baltimore, approximating 150 mgd.

Surely an outstanding use of water conservation and reclamation is that of the Kaiser Fontana Steel Plant near Los Angeles. This plant draws on local ground and surface waters as well as sewage from the nearby community. At a result, the mill produces steel with a water use of only two per cent of the conventional 65,000 gallons per ton of steel. The technical literature in recent years



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WATER CONSUMPTION in the United States (left), and a comparison of water demand with water supply (right).

records many such examples though on a smaller scale.

Increasing regulation of streams by the construction of impounding reservoirs is likely to provide a large portion of our expanded water needs in the next 25 years. In the East, particularly, significant additions to available water supplies would result from this practice.

Ground Reservoirs are Important

The development of new ground water reservoirs is possible even though we hear much about overdrafts of ground water in many locations. In these locations an equilibrium of inflow and outflow will have to be established. Many areas where ground water reservoirs could be tapped are, unfortunately, not in areas which have available the other ingredients for a good industry location besides water—namely labor, markets, and raw materials. The usefulness of ground reservoirs can be increased tremendously by the use of artificial recharging. While this method helps sustain the volumes available, it may also make much greater volumes available by preventing the intrusion of salt water along the Atlantic, Pacific and Gulf coasts.

Other means of augmenting future water supplies include importation of water from an area where it is plentiful, induced rainfall, the production of fresh water from sea water by distillation or iron exchange, or the use of substitutes for fresh water. In the case of the latter, salt water may be used for cooling if the cost of fresh water is too great. Air cooling offers another possibility, as does the use of closed circuits for cooling purposes.

Municipal and Industrial Expansion

The effects of the nationally diminishing water supply have, in the current industrial boom, been most favorable economically to the southeastern United States. The effects on municipal and industrial expansion can hardly be separated. Since industry is the principal reason for the development of cities, municipal and industrial water supply problems tend to merge.

The Materials Policy Commission pointed to the potential additional water supplies as being proportionately greater in the nine southeastern states than in the twenty-two northeastern states. These southeastern states include Louisiana, Arkansas, Tennessee, Mississippi, Alabama, Florida, Georgia, South Carolina, and North Carolina. Availability of water has undoubtedly played a vital part in the South's industrial growth, which reached the astounding rate of one new multi-million dollar plant during each working day of 1951. A glance at this area is sufficient to observe the strong shift from the traditional agricultural economy to an industrial economy.

Another aspect of the renaissance of the South is less obvious but of great importance. That aspect is industrial research which has actually pointed the way for the great industrial expansion. Such research must become and remain mindful of the obligations in the field of water pollution. This does not mean research only to study treatment methods to which hydrowastes will respond; treatment should be the last resort. The fundamental good for the conservation of all resources of the region would be accomplished most by use of processes which (within the limits of economy) would reduce waste to a minimum. The next choice would be to use processes yielding usable byproducts.

It is my hope that sourthern industries and the private as well as public research laboratories in the south will do their very best to develop technological information essential to the solution of stream pollution problems. It is my further hope that southern industries and municipalities, as well as state and regional water pollution control authorities, will cooperate toward the same end. If this course is followed, the ceiling of ultimate industrial development of the region will be raised greatly. If it is not, most of those present may live to see the degradation of southern streams to an extent characteristic of other parts of our country. The Materials Policy Commission suggested that by 1975 water supply may be the most important factor affecting industrial location.

W&SW

GROUP of Sanitary Engineers representing twenty-one countries at 4th European Seminar in Opatija, Yugoslavia.

The Control of Pollution Abroad

Impressions from a brief European visit

by EDWARD J. CLEARY

Mr. Cleary is Executive Director and Chief Engineer of the Ohio River Valley Water Sanitation Comm., Cincinnati, Ohio. This article, prepared at the editor's request, comprises a reconstruction of "off the cuff" remarks of the author before the annual convention of the Fed. of Sewage & Ind. Wastes Ass'ns.

AS A consultant to the World Health Organization, I was privileged to go abroad last Spring under the sponsorship of the Regional Office for Europe of the WHO, in cooperation with the Rockefeller Foundation and the Yugoslav Government. The immediate object was to participate in a seminar on pollution control policy and practice at a conference of sanitary engineers from twenty-one European countries. The conference place was Yugoslavia, a country in which the Rockefeller Foundation has made substantial contributions since 1927 for the promotion of sanitary engineering and public-health training.

A secondary object was for me to observe pollution-control activities in certain parts of England, Holland and Germany, prior to the seminar. Some three weeks were allotted for this purpose, hardly enough time for more than an exposure to some developments, but nevertheless a most rewarding period in terms of renewing old contacts and establishing new ones.

Comments on the Seminar

Locale of the seminar was Opatija, an Adriatic seaside resort of compelling beauty and charm that once was a playground of the Austrian Court. To facilitate exchange of viewpoints the business of the seminar was conducted in two languages—English and French—and simultaneous translation facilities were provided. An IBM wireless system was used, each delegate being provided with a portable receiver and headphones.

Unlike most technical meetings in the United States, where speakers are placed on rather rigid time schedules and subsequent discussion is not particularly encouraged, this week-long European conference would seem to stand quite in contrast. I was informed that the Opatija seminar was typical; and, here is what transpired. Prepared papers on assigned topics were required to be submitted three months in advance; and, these were translated into several languages and distributed to all participants. At the seminar a half day was allotted for the development and enlargement of various points made in a prepared paper, at least one of which was 200 pages long and several others almost as voluminous. Following this there was a full day devoted to cross examination of views, supplemented with discussion and argument on related points. A final half day was then devoted to a summarization of all the viewpoints and the presentation of conclusions. Discussion was then opened on the validity of the conclusions and their resulting modification. It was my feeling that we had rather fully exhausted the subject, to say nothing of the concommitant condition of some of the participants.

Among the conclusions from the

seminar, with regard to the problems of pollution control in Europe were these:

(1) Industrial pollution contributes the greatest amount of stream degradation in many areas of Europe. While seeking means to curb existing sources—which can be done only with the greatest difficulty and which may take a long time—it was agreed that *prohibition of new sources should be immediately enforced.*

(2) Successful control can be exercised only by organizations with *authority over entire river basins.* Steps already have been taken in this direction on an international basis by the creation of a Rhine River Commission on which four nations—Switzerland, France, Germany and Holland—are represented.

(3) Desirable quality of water to be maintained in a river is a matter that should reflect the use to which the water is to be put, and also may depend in considerable degree upon public opinion as to what quality conditions are *within the realm of economic achievement.* Although there was no unanimity as to what constitutes desirable water quality for specific uses there was agreement that rivers should be maintained so as not to be offensive to sight or smell and that pollution loads must not be permitted to exceed the self-purification capacity of the stream. This would constitute a minimum standard of regulation.

OPATIJA, Yugoslavia's resort town on the Adriatic Sea, where Seminar was held.

Complexities of English Practice

Any ideas that I had previously entertained about the complexities of pollution-control practice were liberally confirmed in learning some of the experiences of administrators in the United Kingdom.

There was a peculiar fascination, for example, in the summation made by Mr. A. S. Wisdom, deputy secretary and solicitor of the Conservators of the River Thames, before a meeting of the Institution of Sanitary Engineers. Not only were the technical problems of pollution prevention difficult, he stated; but, on top of that one had also to deal with the law. And the law, he asserted, was a sort of exact science for adding organized chaos and confusion to what one had hitherto thought was relatively simple and straightforward. The law, he pointed out, was divided into two quite separate branches. First, there was the common-law position, which consisted of various decisions given from time to time by the courts; the second branch comprised the statutory provisions relating to pollution. There were about 30 or 40 statutes dealing with pollution; and there were several hundred cases in which the common-law position was dealt with.

Statutory provisions with regard to pollution prevention in England appear to have originated at the time when such enactments were identified with the name of the reigning monarch. We find one titled "27 Henry VII, Chapter 18," which provided for a penalty of 100 shillings to be paid to the King and to the Mayor of London "by any person annoying the Thames or casting dung into the river."

Since that period, some 400 years ago, a variety of laws and administrative devices have been applied to cope with the increasing problem of stream pollution. Finally, in 1948, following several years of intensive study, the Rivers Board Act was enacted. This provided for the establishment of a board for each river or group of rivers in England and Wales.

Some 32 River Boards have been set up. They replace about 45 Fishery Boards, 53 Catchment Boards dealing with land drainage and 1,600 Pollution Authorities. The River Boards took over from the existing agencies all their functions dealing with land drainage, fisheries and pollution and also have the general duty to deal with conservation in their areas.

Meantime, in 1951, a Rivers (Prevention of Pollution) Act was passed. Its purpose: "to make new provisions for maintaining or restoring the wholesomeness of rivers and other inland or coastal waters of England and Wales in place of the River Pollution Prevention Act, 1876, and certain other enactments." The powers in the 1951 Act are given to the River Boards. For example, the consent of an appropriate River Board is required for the discharge of new effluents or effluents substantially altered. A River Board may lay down by-laws (local laws) specifying quality and quantity of discharges to streams. Very importantly, in making such by-laws the River Boards are required to have regard to the character and flow of the stream, the extent to which the stream may be used for industrial purposes, fisheries, water supply, agriculture, transport or navigation.

Incidentally, by-laws must first be confirmed by the central government —in this case the Ministry of Housing and Local Government—before they can be employed by a River Board. To date no by-laws have been formally submitted by any board. Therefore, in the absence of by-laws a River Board cannot prosecute a person or organization which is thought to be polluting a river without first obtaining the consent of the Minister of Housing and Local Government. The central government, therefore, is in a decisive position with regard to pollution control. Only the Thames Conservancy Board (which has been operating since 1865) and two other agencies (Catchment Area of the River Lee and the Surrey County Council) are permitted to exercise certain special and private pollution powers without the necessity for central government approval.

THE AUTHOR with Dr. Geo. Karakassonis, professor of Sanitary Engineering, Athens Polytechnic (center) and Dr. Otto Jaag, director of the Swiss Federal Institute for Water Supply, Sewage Purification and Pollution Control.

The Situation in Germany

In Germany there is no general law with regard to pollution control, although one is currently under consideration. Meantime, there are several examples of unusually effective administrative agencies known as River Associations, which are established under state laws. Those in the Ruhr Valley—where the concentration of industry and the limited water resources made it quite obvious a half century ago that pollution control was a matter of economic survival—claim special attention.

Under a special law of the State of Prussia in 1904 the formation of River Associations was permitted. The manner of their organization and administration, and the degree of success they have achieved in solving problems of water economy, have commanded world-wide admiration. It was not difficult to share this enthusiasm on the basis of what I saw and heard during the course of a brief inspection of the three principal boards in the Ruhr Valley. And, I can only wonder why the experience of these boards has not found fuller application elsewhere in the world where water resources problems are acute, to say nothing of other areas of Germany itself.

The answer, I am told, probably lies in the fact that nowhere has there been a greater consciousness of what water means to industrial, agricultural and urban development than in the Ruhr Valley. Because of the limited size of the rivers and water resources in terms of the demands placed upon them—for domestic and industrial uses, navigation, power production, recreational purposes and waste carriage—a high value has been placed on the means to accomplish maximum river use.

There are some variations in the manner in which these River Associations operate. But, in general, they conduct the studies and make the decisions on how the river shall be used and what works are necessary to secure these uses; they also *design, build and operate* the works and otherwise assume responsibility for maintaining desired conditions.

Administrative procedures are typified by those developed for the Emscher River Association, oldest of the Ruhr Valley group. It includes a board of 100 deputies elected for six years from the towns and rural districts; a managing committee of twelve members chosen by the board for a six-year term and representing the mines, cities, agricultural and industrial interests; and a commission of appeal with nine members, three of whom are appointed by the provincial (state) government and six of whom are selected by members of the board.

Functions of the 100 member board are: To elect the managing committee; to fix taxation principles; to adopt the budget; and to issue loans for public subscription.

Functions of the 12 member Managing Committee are: To deal as the executive body of the board; to prepare the budget and present it to the board; to fix the actual taxes; and to deal with protests concerning taxes.

Function of the 9 member Commission of Appeal is: To hear and decide all disputes in connection with taxes; its decisions are final and not subject to appeal to any other court.

Revenue for operating the Associations is obtained from: (1) taxes on industries, communities and from water-supply authorities; and (2) from the sale of hydro-power, digested sludge, digester gas and land rentals. Bonds of the Associations—which are issued to cover costs of new construction — are said to enjoy a splendid credit rating both in Germany and abroad. Their safety from an investment standpoint is enhanced because of the joint liability of all members of a river association and by the fact that tax liens—being a public agency charge—have priority over any private debts of the members.

Some idea of taxation principles and budget requirements may be gleaned from current operations of the Ruhrverband, which is the second oldest and largest of the Ruhr Valley river associations. The distribution of the overall tax is 27½ percent among the industrial participants; 27½ percent among the communities and 45 percent among water supply authorities (for benefits received). The 1954 operating budget in American dollars totalled about $2,500,000. Of this amount some $750,000 is secured from sale of power, gas and sludge and from land rentals. The balance of $1,750,000 is to be raised by taxation.

Further details on how work is financed were given to me by the Ruhrverband chief engineer, Dr. H. Rohde, in these terms:

The tax-obtained money is used to cover all expenses, including interest and amortization of loans, administrative costs, operating costs of treatment plants and renewal equipment.

When the Ruhrverband decides that a town or an industry should install a treatment facility the cost of this work is not charged to the specific municipality or industry but is assumed by the board. The manner of assessment was introduced nearly 20 years ago in order to minimize the opposition of the towns against new projects of the Ruhrverband. Whereas formerly there had been opposition from certain towns regarding construction of a treatment facil-

ity because of the consequent unavoidable tax increase, now—on the contrary—the towns are pressing the Ruhrverband to do something for them because the construction costs are assessed on all taxpayers in the area served by the Ruhrverband.

The construction costs of new plants or for the extension of existing plants is obtained from bond issues floated by the Ruhrverband. For example, the 27½ percent paid by all the industrial participants is used within the ordinary budget to cover the expenses for interests and amortization of the loans, operation, salaries and labor costs of all the industrial treatment plants in operation. The cost of new plants built by the Ruhrverband for the treatment of industrial wastes are covered from loans. The costs for plants for the pretreatment of industrial wastes—as for instance, recovery plants for pickling liquor, plants for the removal of metal salts from plating-wastes or any other measures to be taken by an industry in order to insure proper operation of the treatment facilities plants run by the Ruhrverband—are carried by the industry itself.

THE AUTHOR and DR. KARL IMHOFF, from whom the author learned at first hand how the Ruhr Valley pollution control program was brought to its present high state of perfection.

DR. WILLEM RUDOLFS brought back memories of inspirational experiences of the author's graduate-student days under the good Doctor at Rutgers University. Now in retirement he lives in Joppe, Holland.

BRITISH DELEGATES, G. M. McNaughton, chief engineer, and Dr. Arthur Key, senior chemical inspector, Ministry of Local Government and Housing. Dr. Key is president of the British Institute of Sewage Purification.

Some Broad Conclusions

Although my opportunities for observation were limited by time and circumstance I did have the unique and rewarding experience at the seminar of living and working for ten days with 51 of Europe's experts in matters pertaining to pollution control. And I had the further advantage of a happy association for many days with Dr. Arthur Key, senior chemical inspector of the British Ministry of Housing and Local Government, who had recently completed for the WHO a comprehensive study of water pollution control in Europe. The following conclusions in large part reflect an interpretation of viewpoints expressed by Dr. Key and other experts at the seminar.

Water utilization in Europe differs markedly from that in the U.S.A. While three-quarters of our water is taken from surface supplies and the remainder from groundwater sources, almost the exact reverse is the situation in Europe. This fact taken in conjunction with the relatively low consumption of water explains in good part why limited attention has been given in most parts of Europe to the problem of pollution control.

In certain areas effective measures for control of pollution have been instituted, but these are confined to places where the extent of pollution has jeopardized further development of industry than the public health.

There are great differences among countries in laws relating to pollution, in the organizations established to control it, in public and official attitudes toward it, as well as the manner in which the problem is handled.

Akin to observations in the U.S.A., there is lack of agreement as to what the overall aim should be in dealing with pollution. There are idealists who find it difficult to understand why any activity of mankind should be permitted to influence the quality of rivers — discharge of any waste effluent prior to complete purification is ruled out in their thinking. This attitude, states Dr. Key, is typified by the age old "common law" of England, which maintains that the owner of the banks of a stream is entitled to receive water of the stream in its natural state.

At the other extreme, there is the attitude of complete unconcern about pollution until the effects of waste discharge result in a nuisance. While it cannot be said that such an attitude finds official expression there is evidence, nevertheless, that it exists.

Between these extremes there are a variety of viewpoints. For example, there is one that evaluates pollution only on terms of its effect on fish. Since fish kills are an obvious result of pollution it is understandable why in some countries pollution-control laws designed to protect fish have been in existence for a century or more. Another attitude reflects the view that pollution need only be prevented when it becomes a menace to public health; in some countries this is the only official ground on which action can be initiated.

Laws relating to pollution control and practice relating thereto are quite different things. Some laws are so idealistic in their concept that it is impracticable to obey them and in places where the most stringent requirements are laid down the law is simply ignored. It would appear that "where too much is asked too little is obtained."

Heavily underscored in my notes is a comment by Dr. Key that expresses a philosophy whose application in the United States should claim as much consideration as might be given to it in Europe. He said: "The condition in which we seek to retain a river depends *not only on what is desirable but upon what is practicable.* It should represent a proper balance of interest between all those who use the river—those who discharge into it, those who take water from it, and those who use the water in it for boating, fishing, bathing, navigation or even as an added attraction to the countryside."

Water Main Cleaning and Lining

A review of the technique and advantages of these practices

by J. A. FRANK and A. G. PERKINS

Mr. Frank is Vice-Pres.-Genl. Mgr., National Water Main Cleaning Co., New York, N. Y., and Mr. Perkins is Sales Manager for the Centriline Corp., New York, N. Y. Their paper was presented at the 1954 meeting of the Southwestern Section, A.W.W.A., and has been released for publication in *Water & Sewage Works*.

THIS discussion is designed to explain and illustrate the "why, when, and how" of cleaning and lining water mains. When the carrying capacity of mains decreases, there is a corresponding decrease in the serviceability of the system. Briefly, the need to recover water main capacity is "why" water mains are cleaned.

The curves, Figs. 1 and 2, show the population increase of all the cities in the Southwest Section which reported answers to an AWWA questionnaire, both in 1945 and in 1950. Fig. 1 illustrates trends of cities below 400,000 and Fig. 2 for those of cities above 400,000 population levels.

Examining two sets of curves, we find that there are two cities having negative slopes, indicating loss of population; these two exceptions were caused by military installations which were inactive after World War 2. The conclusion to be drawn from these curves is that, except for distortion caused by war, the population of each city has increased. Consideration of the slopes of these trend curves also indicates that the rate of increase of population becomes increasingly rapid as the population becomes greater.

Increasing Water Consumption

Trend curves for all cities in Figs. 1 and 2 show that the only slopes which are negative are for the cities in which the demand curve is distorted by military installations.

Fig. 4 illustrates the demand for water shown by these cities. The demand, as figured here, is the product of the population times the per capita water consumption. By reexamining Figs. 1 and 2, it will be apparent that the demand is cumulative: as the population increased, the per capita water consumption increased at a faster rate. Thus, the slope of the curves in Fig. 4 is much greater than the slope of the population curves; as pointed out before, the per capita water consumption increases more rapidly as the population increases and, therefore, the slopes on Fig. 4 are a reflection of the cumulative effect of increasing per capita water consumption at the same time the population is increasing.

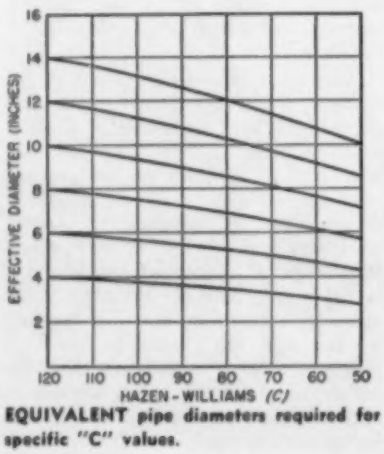
Unaccounted-for Water

Also to be noted is the fact that the slope becomes steeper and steeper as the city grows larger in population. In plotting these data, the unaccounted-for water (the difference between the total quantity produced and the total amount sold) varies; in some cases the amount is as high as 40 per cent. It is interesting to note that, in the cities where the unaccounted-for water is held to 15 per cent or less, each city has had Pitometer surveys made.

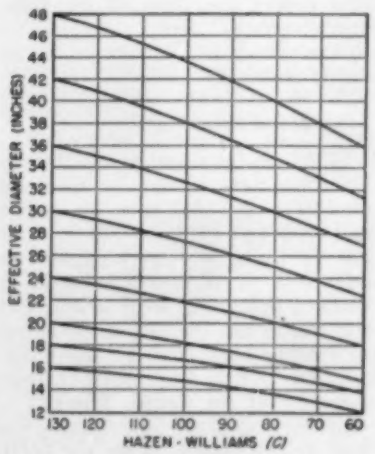
In summing up, we can conclusively see that Fig. 4 indicates the demands on the water distribution systems have become greater and greater. New pipe to take care of this growing demand has not been laid as rapidly as the demand has increased.

The loss of coefficient for the various sizes of pipe as predicted in the Hazen & Williams Handbook is illustrated in Fig. 3. Note that this is a family of curves, and that the centroid of the family has been drawn as a heavier line. The significant point to be noted is that, while the demand on the systems has been going up and up, the coefficients or ability to supply demand has been decreasing at the rates shown.

The equivalent diameters required for pipes as they lose coefficient is



EQUIVALENT pipe diameters required for specific "C" values.



Charts courtesy of Clinton Inglee, reproduced from Jour. A.W.W.A.

illustrated in the Hazen-Williams "C" valve graphs reproduced herewith. Since the total investment in water mains in the U. S. is estimated at four and one-half billion dollars, a tremendous amount of capital investment is being lost due to loss of coefficient.

Summing up, we find that the load on the water lines is increasing at a very rapid rate, which is cumulative, and that the ability to serve (the capacity of the pipe lines) is dropping at a very alarming rate. Thus, if we can recover the loss of coefficient, and the resultant loss of capacity, we are then in a position to improve and recover this loss in capital plant.

Water Main Cleaning Methods

The process of water main cleaning can be divided into two separate divisions which in the case of smaller pipe, consisting of 4-in. and 6-in. sizes, we will call "drag work." Cleaning of 8-in. and larger diameters is done by the "pressure method."

Drug Method

After preliminary work, such as excavation, notification, etc., the drag work process consists of isolating the main to be cleaned, then making a cut at the entrance point and a cut at the exit point. The nipples cut out of the main usually are 28-in. in length.

A light cable is extended through the water line from one end to the other, either by means of jointed rods or a piston-like device called a carrier. A "make-up," which allows temporary repair at the starting point, and a stuffing box are next installed. The water pressure in the main propels the carrier, which drags the light line through the main behind it. Fig. 5 shows the "make-up" used with fire hose connections.

After the light cable is run through the main, the cable from a power winch, usually ⅜-in. in diameter, is pulled back to the starting point and the "drag" tool is attached to this heavier cable. After the cleaning tool is pulled into the main, entrance to the main at the starting point is permanently repaired, using Dresser couplings or solid sleeves.

Water is turned on so that, as the cleaning tool is pulled through and scrapes the deposit from the interior of the main, the water flushes the dirt ahead of the cleaning tool to the exit hole. When the cleaning tool emerges at the exit point, the line is thoroughly flushed and then is shut down long enough to permit permanent repair at the exit hole. The air is vented from the line and the line is restored to service. It is good practice to shut off the various service connections while cleaning proceeds, in order that the debris will not enter the service lines.

POPULATION GROWTH of cities in Southwest Section of A.W.W.A. (based on 1945 and 1950 data).

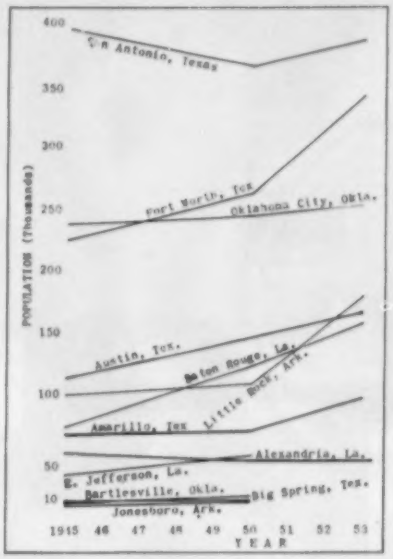


Fig. 1—Cities below 400,000 population levels.

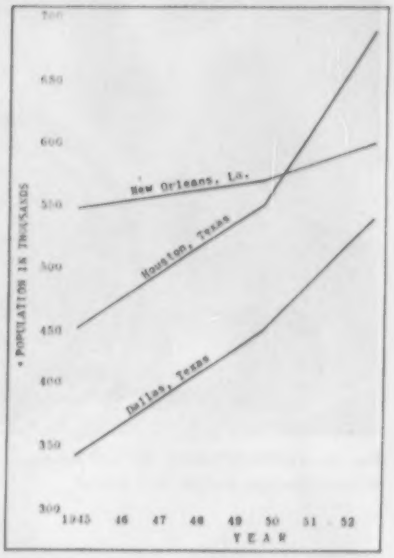


Fig. 2—Cities above 400,000 population levels.

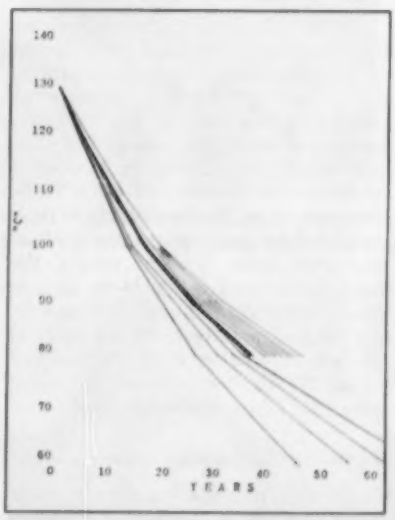


Fig. 3—"C" Value vs. Time Family of curves for various pipe sizes, based on Hazen & Williams Handbook.

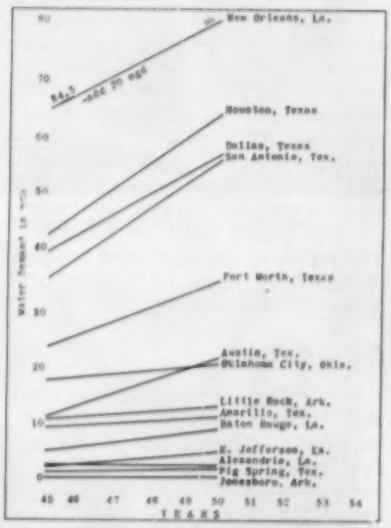


Fig. 4—Water Demand vs. Time Calculated as the product of population multiplied by per capita water consumption.

Pressure Method

The pressure method of cleaning includes the same preliminary steps as the drag method, namely, excavation, notification, and isolating the main. The main is then shut down, and nipples varying in length from 6 feet to 9 feet are cut out both at the entrance and exit holes.

There are two methods of entering the cleaning tool into the main. The first consists of pulling the cleaning tool into the nipple by means of a horizontal tripod braced against the nipple and using a jack, such as a coffing-hoist, to pull the machine into the nipple proper. Fig. 6 shows how

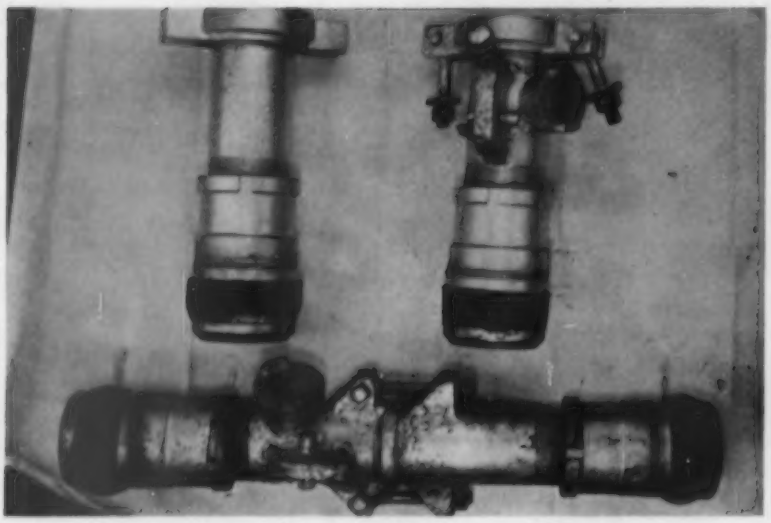


Fig. 5—CONNECTIONS for fire hose are made by these "make-up" devices. Water pressure propels the carrier.

Fig. 6—CLEANING TOOL inserted in nipple by using a jack.

this is done. This nipple, with the machine inside it, is then put back into the main by means of Dresser couplings or solid sleeves.

The water is turned on, and the rate of travel of the cleaning tool is adjusted to between 50 and 100 feet per minute. The cleaning tool, which uses pistons to propel it, has adjustments to permit more or less water to pass through the machine and to flush the dirt ahead of it. When the cleaning tool emerges at the exit point, the line is shut down after flushing. The nipple at the exit point is again recoupled by means of Dresser couplings or solid sleeves.

Cutting the Pipe

In the past, the cutting of the water pipe has always been a time-consuming practice. We are today using multiple cutters so that four cuts may be made simultaneously, thus reducing the length of time the main is out of service.

Fig. 7 shows the set-up using two A. P. Smith cutters which are mounted on the pipe prior to shut-off. These employ specially designed high-cycle electric motors, and are capable of cutting any cast iron pipe in 15 minutes or less. We also use an air-operated saw, and Fig. 8 illustrates two of these saws set up on the pipe. These particular saws have great versatility and are suitable for cutting pipe from 10-in. up to and including 60-in. diameter. These air-powered Wachs saws will cut a cast iron pipe of any thickness in a number of minutes equivalent to the diameter of the pipe. Both cutters illustrated are capable of producing clean, even cuts.

Disposal of Waste Water

In the past it has been difficult at times to properly prepare for disposal of the quantity of wash water resulting when large diameter mains were cleaned in city streets. We have developed a technique, using line caps and small size valves, to hold to a minimum the quantity of water to be disposed of at the exit point. Figs. 9 and 10 show such set-ups on a 24-in. cast iron main. By this means, the total discharge from a 24-in. line, is easily handled by means of two 8-in. discharge lines. Recently we handled the total discharge from the cleaning of an 84-in. steel conduit by using only two 12-in. discharge lines.

Radio for Operations Control

Another modern practice in water main cleaning is the use of two-way radio to control the operation. Two-way radio has been so highly developed and is so successful that we wonder how jobs presently considered routine could have been handled without the use of radio in the past. Positive and instantaneous control of hydraulic grades by two-way radio during the water main cleaning has proven to be advantageous.

The combined use of the line cap and discharge lines with two-way radio control allows the line to be fully charged at all times, and the speed of the machine is regulated by the amount of opening of the discharge valves. One of the hazards, that of the possibility of collapsing the pipe, has been completely obviated; thus, the use of this method of cleaning allows water mains to be cleaned even though the head of water is exceedingly high.

In the past, large diameter machines were awkward and jacking the machine into the main was a time-consuming, laborious process. An 84-in. cleaning tool may now be jacked into a steel main, using our modern, long-stroke hydraulic jack. This operation has been reduced to a matter of minutes, while in the past, hours and sometimes a full day might be consumed in the operation.

Cleaning and Lining Experience

For photographs illustrating the interior of water mains prior to cleaning, and after cleaning, see *Water & Sewage Works* Reference and Data Edition, May, 1954, pages R-23 to R-32. The quantity of material removed from 7,000 feet of 24-in. cast iron main recently on a job at Lynbrook, Long Island, N. Y., is illustrated in Fig. 11.

Where there has been deterioration of the original pipe, serious consideration must be given to rehabilitation by means of a cement-mortar pipe lining, which not only will preserve the coefficient of carrying capacity, but will stop leaks. This consideration applies to graphitic corrosion in cast iron mains as well as to the deterioration of steel mains.

It has been very general experience that, unless corrective chemical treatment is instituted, a pipeline coeffi-

cient will be reduced more rapidly after cleaning than its previous rate of reduction. This is unquestionably caused by inability to do a good job of cleaning without seriously damaging the already penetrated original interior protective coating.

Cement Mortar as Protective Lining

The use of cement mortar as a protective lining for water pipelines has a history of over 100 years. As early as 1836, a report of the French Academy of Science recognized the use of cement mortar linings prior to that date. The history of cement lining in the U. S. began before 1850, when cement lined and coated sheet metal pipes were first used in carrying aggressive waters by Atlantic Coast cities.

Some of these early pipelines are still in service. Harold Ohland, Division Engineer of the Jersey City, N. J., water system, has reported on an 8-in., light-gauge metal pipe, having an interior and exterior covering of cement mortar, which was put in service some time prior to 1885, the year of his oldest record of the line. That pipeline is still in service today, and there is no immediate plan for retiring it.

Figs. 12 and 13 illustrate a 16-in. pipeline removed from service in Jersey City in June, 1947; the pipe was laid in 1858. It consists of approximately 14-gauge wrought iron sheet, riveted as shown. The inside was protected by a layer of cement mortar lining about ½-in. thick. This pipe was free of tuberculation or corrosion, and the shell was water-tight after 89 years of use carrying an aggressive water.

The success of cement mortar to protect metal pipe from corrosion has been discussed in many published articles. James E. Gibson, Manager, Water Dept., Charleston, S. C., and Harry Y. Carson, Research Engineer, American Cast Iron Pipe Co., were particularly interested in the early 1920's in a lining for cast iron pipe which would withstand the very aggressive water of Charleston. Their studies of the behavior of cement mortar in pipelines (which at that time had been in use for over seventy years) led to the installation, by the City of Charleston, of the first known cast iron pipe having factory-applied spun cement mortar lining. This type of cement lining for new cast iron pipe is now common in modern practice.

While experience has demonstrated that pipes properly cement lined at the factory would not corrode or tuberculate on the inside, many pipelines are installed to carry aggressive waters without cement mortar protection. Once the original paint, tar,

CUTTING PIPE. (Left) Fig. 7—High-cycle electric motor A. P. Smith units. (Right) Fig. 8—Air-operated Wachs saws will cut all C. I. Pipes.

WASH WATER DISPOSAL. Figs. 9 and 10—Line caps and small size valves enable two 8-in. lines to handle discharge from 24-in. main.

DEBRIS REMOVED. Fig. 11—This quantity of material resulted from cleaning 7,000 feet of 24-in. main at Lynbrook, N. Y.

or asphalt coating applied to new pipe at the factory has been penetrated, water comes in contact with the metal and tuberculation starts. The effect of tuberculation on carrying capacity during times of rising demands, and the resulting need for main cleaning, have been described.

Experience with Aggressive Water

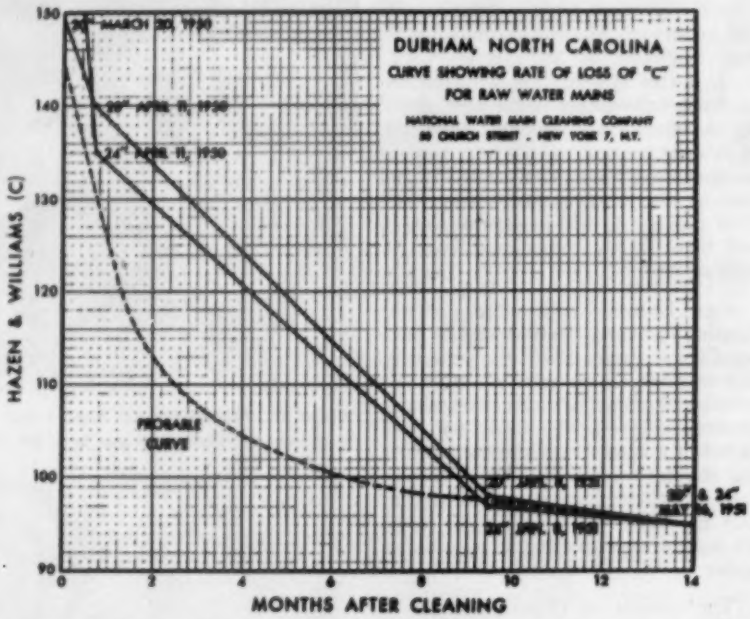
The need for protective treatment in addition to cleaning is evidenced by the fact that pipelines re-tuberculate after cleaning. In fact, re-tuberculation develops more rapidly after cleaning than before. Fig. 14 illustrates the loss of coefficient in water pipelines after cleaning. These data represent about ten years of experience in Durham, N. C.

It should be noted in Fig. 23 that the two lines, hydraulically parallel, show about the same characteristics in loss of coefficient. By 1951, nine months after cleaning, both pipelines had lost about 40 points on the Hazen and Williams scale. This program of cleaning, started in 1940, had made it necessary by 1950 to re-clean every year. The cleaning was timed for late spring so that maximum delivery of both pipelines was available for the summer peak load.

Another example of the effect of extremely aggressive water is in Charleston, S. C. Mr. Gibson stated, in a report published in the New England Water Works Journal in 1926: "The Charleston Water Department had experienced for years a material falling-off in the carrying capacity of the cast-iron mains throughout its distribution system. This was particularly called to their attention in the constantly increasing friction head of their twelve miles of 24-in. cast-iron main between their pumping station and the center of distribution. This main had been cleaned three times, with the result that after each cleaning the friction losses increased very much more rapidly, and in the last cleaning 80 per cent of the results from cleaning had been overcome within 30 days after cleaning. That is to say, the coefficient after cleaning had been restored to practically that of new cast-iron pipe, but within 30 days after the date of cleaning this coefficient had again decreased until it was practically the same as that before cleaning."

The Durham and Charleston examples are chosen as the extreme in re-tuberculation, and are not typical of less aggressive waters.

90-YEAR OLD PIPE. (Left) Fig. 12—Jersey City's 16-inch, riveted wrought iron line. (Right) Fig. 13—inside protection by cement lining.



RE-TUBERCULATION. Fig. 14—Experience shows pipelines tuberculate more rapidly after cleaning than before they are cleaned.

Cement Lining Pipelines in Place

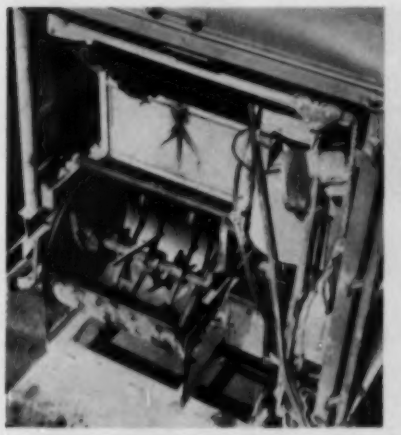
Until 1933 there was no satisfactory method for placing a cement lining in large pipelines already installed. During that year a process for cement lining pipelines in place was invented and developed by Albert G. Perkins. This process had its first field trial on a short section of an installed 72-in. line in Jersey City, N. J. The process is known today as the Centriline process of centrifugally applying cement mortar.

The test at Jersey City received little publicity, but its success led to the cleaning and lining of over 27,000 feet of old 48-in. riveted steel line supplying Newark, N. J., from Macapin intake. The cement lining of this pipeline not only restored capacity lost through tuberculation, but exceeded by 14 points on the Hazen and Williams scale the original clean pipe capacity. The improved capacity resulted from the streamlining of surface over the large rivets on the inside of the pipe. In addition, the lining stopped all leakage through holes in the pipe wall caused by interior or exterior corrosion.

Because of an intense need for a method of cement lining pipes in

place, this first contract aroused much interest in the waterworks field. Papers by Banks and Inglee were published and an editorial by William W. Brush described the "making of the Newark line better than before" as "a noteworthy achievement in the water works field."

The success of the first 48-in. job led to the development of machines and equipment for the lining of smaller diameter pipe. The first step was to line 36-in., then 30-in., and then 24-in. diameter pipe. It was believed for some time that 24-in. was the smallest diameter pipe which could be lined by a proportionate reduction of the original lining machine, since it is considered the smallest size pipe in which a man of normal size can enter the pipe, turn around, and leave the pipe.



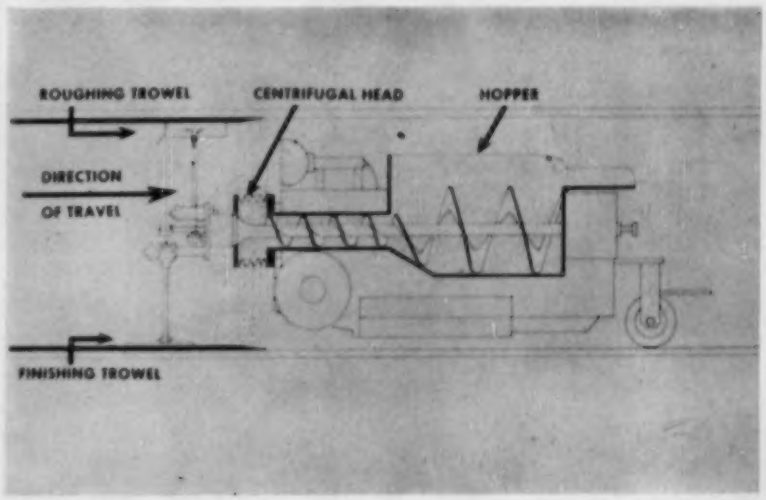
LINING EQUIPMENT. (Left) Fig. 15—Electrically driven mortar mixer. (Right) Fig. 16—Travel buggy carries mortar through pipe to lining unit.

Field Equipment for Lining

In this size range, a typical field setup would include a trailer stationed at the entrance of the excavation. It provides an electrical generator which supplies power to all of the lining units and support equipment. Mortar for lining is mixed in an electrically driven, specially designed mortar mixer mounted in the rear of the trailer, Fig. 15. Special attention is given to the slump of the mortar. The capacity of the mixer is such that ample mixing time is assured.

Mortar ordinarily is discharged directly into a chute which carries it down to a "travel buggy," Fig. 16. Trailing an electrical supply cable, the "travel buggy" carries a supply of mortar through the pipe for a distance of approximately 1000 feet to the lining unit. The lining unit starts operation at the maximum operating distance from the supply excavation and works toward it.

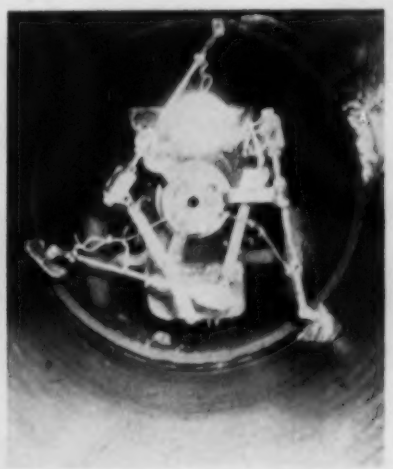
A "mortar supply buggy" which travels with the lining machine receives the full charge of mortar from the "travel buggy" and feeds the mortar continuously into the lining machine hopper while the travel buggy goes back for another load. In the hopper, the mortar is carried by a screw type conveyor through a tube into the center of the applicator, Fig. 17. At this point, a device extrudes the mortar evenly in all directions through slots in the tube—forcing it directly into the base of the blades in the rotating applicator.



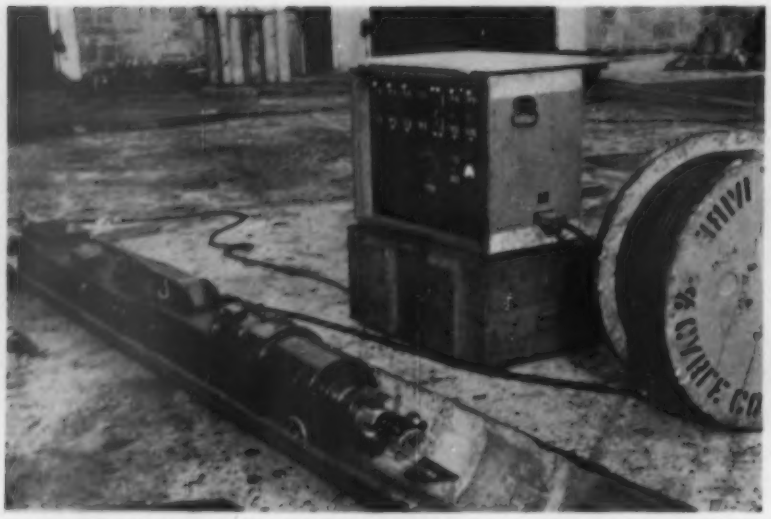
LINING APPLICATION. Fig. 17—Within the water main, mortar is extruded and then trowelled to walls of pipeline.

The Centrifugal Applicator

The centrifugal applicator rotates



INTERIOR LINING. (Left) Fig. 18—Machine started at this end. (Right) Fig. 19—Trowel end of 30-in. lining machine in action.



AUTOMATIC LINING MACHINE. Fig. 20—Remote control operates this unit designed to fit pipe diameter of 16-in. size.

at approximately 1000 rpm and throws the mortar onto the pipe wall in a steady stream of fine particles. Projecting behind the centrifugal applicator is a slowly rotating frame on which two or three finishing trowels are mounted. The trowels are held against the freshly placed mortar by a light spring pressure, in order to flexibly align the trowel and to produce a very smooth lining surface.

Fig. 18 shows where the lining machine started operation in a 36-in. cast iron pipe, and reveals the unlined portion at the edge; beyond the cement mortar may be seen as it was projected before trowelling; and farther back, the troweled section as the trowels were released onto the mortar surface. A lining machine in operation inside a 30-in. pipe is illustrated in Fig. 19.

Lining thickness is changed by varying the travel speed of the machine. Thickness of the lining depends on the size and condition of the pipeline. Most cement linings are from 3/16 to 3/8 inches in thickness.

Automatic Lining Machine

All machines to line 24-in. and larger sizes of pipe were designed to be accompanied through the pipeline by an operator. Since it was originally considered impractical for a man to work in pipelines smaller than 24-in. in diameter, Centriline in 1950 built a machine which could be operated entirely by remote control. This machine was designed to operate in pipe diamters as small as 16 inches, Fig. 20. The new unit is sometimes referred to as the automatic lining machine, since the various operations are automatically coordinated or are electrically or mechanically interlocked to control proper sequence of operation.

The cement mortar is pumped through a flexible hose to the automatic unit at a rate which is automatically coordinated with the demand of the machine. The hose through which the mortar is forced is automatically retracted ahead of the machine by a winch located on the surface of the ground. All functions of the machine can be controlled from a switchboard on the surface, Fig. 20. The basic principle of applying the mortar is the same as in the larger machines.

In spite of original doubt that it was feasible for men to enter 16-in. pipe, all 16-in. and larger pipes lined are now inspected before and after lining by men traveling through the pipe on wheeled carriages.

In the centrifugal method of lining pipes, the pipeline fittings such as valves, tees, and corporation cocks offer no problem—only the amount of mortar to produce the required thickness of lining is projected from the center of the pipe by the applicator. Any special fittings are easily shielded or plugged prior to the passage of the lining machine. After the lining has been placed and has taken its initial set, a man enters the pipe to remove plugs and to execute any minor hand work which might be necessary at special pipeline fittings.

Additional Methods of Lining Pipe

Two other methods for applying cement lining in large pipelines have been used in the United States since the development of the centrifugal process. One method utilized compressed air to blow cement, sand, asbestos and water onto the wall of the pipe in a manner similar to a slowly rotating cement gun. The second method utilizes compressed air to blow premixed mortar through slowly rotating tubes to the wall of the pipe.

The Tate Lining Process

A method of placing a cement lining in small diameter pipelines was invented by William T. Tate of Sydney, Australia. This method has been used in the United States since 1937 for lining pipes from 4 to 14-in. in diameter.

The Tate process utilizes a bullet-shaped tapered lining tool to press the cement mortar on the side of the pipe. Excavations for lining are made at approximately 300-foot intervals. The pipe is cleaned by conventional methods using a cable-drawn or hydraulic cleaning tool. Cleanings of debris and water are removed by rubber discs drawn through the pipe, Fig. 21.

With a cable threaded through the section of pipeline being cleaned, sufficient mortar to line the entire section is forced into one end of the pipe. The cable is fastened to the lining tool, and the tool then is drawn slowly through the pipe section by means of a winch located at the opposite end of the pipe section.

The lining tool, Fig. 23 consists of a hollow bullet-shaped mandrel which tapers up to a maximum diameter about ½-in. less than the inside diameter of the pipe to be lined. Guide springs hold the mandrel centered in the pipe so that there is about ¼-in. clearance between the trailing edge of the lining tool "skirt" and the pipe wall. The "skirt" is perforated by several rings of closely spaced small holes.

As the lining tool is drawn through the pipe, the mortar pushed ahead of it creates a back pressure which keeps the space between the lining tool and the wall of the pipe filled with mortar. Since the skirt on the lining tool is tapered, the mortar is firmly pressed against the wall of the pipe. The re-

sulting pressure forces water and some cement through the small holes in the skirt, leaving firm and smooth mortar around the wall of the pipe and a "flat" in the bottom consisting of excess cement squeezed out of the lining.

Special fittings, corporation cocks and valves are excavated and temporarily removed when lining with the Tate process. The winches which pull the various tools through the pipe are located at opposite ends of each section. These are rigged as shown in Fig. 23.

Cement and Sand Specifications

Cement and sand are carefully chosen for this type of work. The sand must be clean, sharp silica sand, and must meet certain grading standards.

Cement ordinarily used is Portland Type II. This often is blended with natural cement, or with high grade pozzalanic material. The ratio used is five parts Portland Type II to one part natural cement or pozzalanic material. The ratio of sand to cement varies from 1.0 to 1.5 parts of sand to 1.0 part of cement.

Advantages of Mortar Lining

There are important reasons for the adaptability of cement mortar to the lining of pipelines in place.

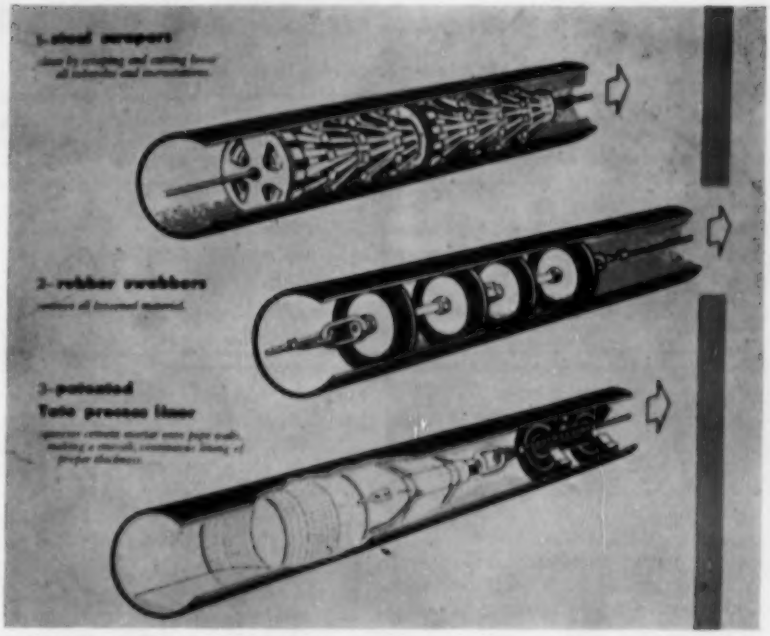
(1) The normal moisture inside a buried pipeline provides a condition to which cement is best suited. Cement mortar lining develops its highest strength when kept saturated with water.

(2) Pipe surfaces cleaned by conventional methods retain particles of the original coating and the corrosion products. Under these circumstances, complete dependence cannot be placed only on a bond between the lining and the pipe surface to hold the lining in place. Cement mortar has the high compressive strength necessary to hold itself in position as an arched ring on the inside of the pipe.

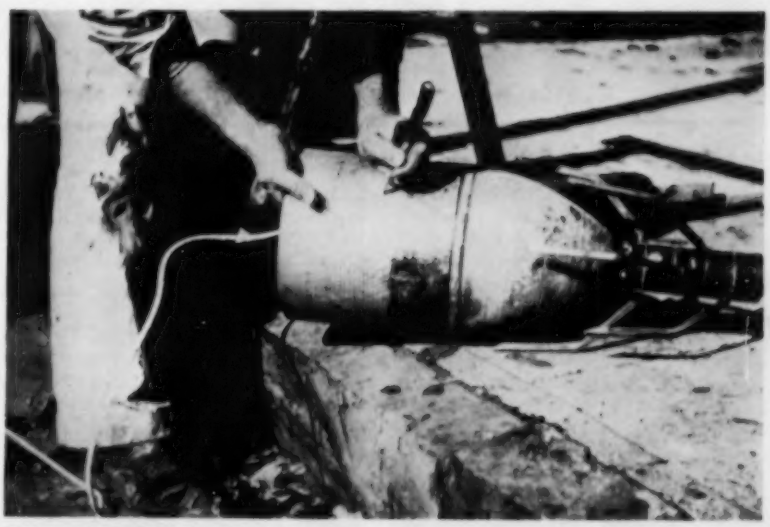
(3) Steel pipelines in many instances have been pitted through because of outside or inside corrosion on local areas. Cement mortar has the strength necessary to bridge these holes and to prevent leakage, even when the pipe is carrying water at high pressures.

(4) The chemically alkaline nature of cement mortar is an important factor. No thin lining material can be expected to completely isolate the inside surface of a long length of pipeline from corrosive water throughout long years of service. The pH value of moisture which penetrates a cement mortar lining is increased to a level which is non-corrosive to ferrous metals. To maintain this condition the mortar must remain continually saturated (as is the case in water pipelines). The "zone of alkalinity" created at the surface of the pipe wall prevents tuberculation and corrosion.

(5) The adaptability of cement mortar to forming a very smooth surface which will provide high pipeline carrying capacities.



CLEANING AND LINING. Fig 21—Above are scrapers and swabbers for cleaning; and below, Tate process lining tool.



LINING TOOL. Fig. 22—The hollow bullet-shaped mandrel, centered by guide springs to give ¼ in. clearance at "skirt" end.

Experience with Cement Lining

A few examples of actual results produced by cleaning and lining mains are given in Table 1.

At National City, Calif., a water system owned by the California Water and Telephone Co., a 24-in. riveted steel light gauge pipe was cement lined in 1948. This was the first 24-in.

TABLE 1

Results of Cleaning and Lining Water Mains

Municipality	Diam. of Main Inches	Type of Main	Length of Main 1,000 ft.	"C" value before cleaning and lining	"C" value after cleaning and lining
San Francisco, Calif.	58	Steel	125	90	135
Trenton, N. J.	48	Lock Bar Steel		108	144
Cincinnati, Ohio	36	Cast Iron	12	90	140
Atlanta, Ga.	30	Cast Iron	15	60	142
Durham, N. C.	20 & 29	Cast Iron	150	90	133
Concord, Mass.	16	Cast Iron	12	60	124

pipe lined on the west coast. The pipeline had so many leaks that as many as 126 redwood plugs were driven into a single 20-ft. length. Leakage from the 26,000-ft. main amounted to one-half of the total flow into the pipeline. After lining, there was no leakage whatever from this line. It is in service today, still with no leaks, and delivers water under a pressure of 80 psi.

At Montreal, Canada, about 36,000 feet of 36-in. and 48-in. Lock Bar steel main was lined in 1946. For about ten years previously, a large portion of this pipeline had been discontinued from service because of a serious leakage problem. The remainder of the line was still in service in 1946, but was leaking badly. According to a report by F. Y. Dorrance, Engineer in Charge, City of Montreal, these lines have remained free from leakage.

Experiences such as those cited have been responsible for the increasing rehabilitation of pipelines in place by cleaning and cement lining. They demonstrate that pipelines can be maintained with a high carrying capacity and with freedom from leakage. From a modest beginning, with completion of the first contract of 27,500 feet in 1936, the use of cleaning and cement lining practices has grown steadily. Today almost four million feet of pipe (sizes 16 inches and larger) have been cement lined.

W&SW

CABLE WINCH. Fig. 23 — To pull tools this arrangement is used.

"Art" Bell Made Water Co. Executive

V. O. Ketcham, President and General Manager of the Stamford Water Co., Stamford, Conn., has announced the appointment of E. Arthur Bell of Essex Fells, N. J., as Executive Assistant to the President, and Chief Engineer of the Company.

Mr. Bell is a graduate of Rutgers University (B.S. 1928), from which he received the degree of Civil Engineer in 1936.

Immediately after graduation in 1928 he became associated with Clyde Potts, Consulting Engineer of New York, as assistant resident engineer on the construction of various water supply, sewerage and sewage treatment systems. In 1932 he was advanced to resident engineer in charge of projects of the same type.

In 1937 he became Water Superintendent of Essex Fells, N. J., which position included the engineering and managing of the water system supplying Verona, Caldwell, North Caldwell, West Caldwell, Roseland and Essex Fells, New Jersey. This post he leaves to become associated with The Stamford Water Co.

From Oct. 1943 to Dec. 1945 Mr. Bell was on leave of absence to serve in the U. S. Navy, Civil Engineer Corps. This period of war service was spent as Specialist Officer, Water Supply and Sanitation.

A licensed Professional Engineer in the states of N. Y. and N. J., Mr. Bell is a member of the Am. Water Works Assn., the Am. Soc. of Civil Engrs., the Natl. Soc. of Professional Engrs. and the Am. Public Works Assn.

A Decade Of Fluoridation At Grand Rapids, Mich.

We quote from the *Michigan Water Works News*, the publication of the Division of Engineering, Michigan Dept. of Health, February 1955 issue:

"On January 25, 1945, Grand Rapids started to add sodium fluoride to its water supply. It was the first city in the world to start this procedure to reduce dental decay. These ten years have produced factual information substantiating the early contention that if fluoride found naturally in water will reduce dental decay, then the same results should be obtained by adding the same chemical to a water supply. These facts are born out by the examinations made of school children in Grand Rapids."

A complete tabulation is included to present data on the reduction of decay in the permanent teeth of children, 5 to 16 years of age, after using fluoridated water for periods of one to nine years. We cite below the impressive data for those having the longest exposure.

Per Cent Reduction in Number of Decayed Permanent Teeth Per Child

Age Years	After 9 Yrs.	Age Years	After 9 Yrs.
5	—	11	51
6	76	12	41
7	62	13	48
8	52	14	46
9	53	15	22
10	51	16	29

Designing, Constructing and Maintaining Centrifugal Pumps

Part 5—Wearing Rings (Second Installment)

by ROY CARTER and IGOR J. KARASSIK

Mr. Carter is manager of the Volute Pump Section, and Mr. Karassik is manager of the Multistage Pump Section, Centrifugal Pump Division, Worthington Corp., Harrison, N. J. This new series has been prepared by Messrs. Carter and Karassik to review characteristics of centrifugal pumps for water and sewage service.

THE first installment in our discussion of wearing rings (Part 4, February issue, page 70) discussed various leakage joints and wearing rings using radial clearances. There has been some use made of leakage joints in which the leakage is controlled by an axial clearance. This type is used by one or two sewage pump manufacturers, employing a leakage joint as illustrated in Fig. 1.

A leakage joint of this type usually requires a means of adjusting the position of the shaft so that the proper clearance can be obtained. With such provision, if uniform wear occurs over the two surfaces, the original clearance can be restored by adjusting the position of the impeller. Naturally, there is a limit as to the amount of wear that can be compensated for by this provision, as the impeller should be located in a nearly central position in the casing waterways.

Axial Clearance Leakage Joints

Generally leakage joints using axial clearances have not found favor in double suction pumps, as such joints necessitate very close tolerance in machining the fit of the rings in reference to the center-line of the volute waterways. Joints with radial clearances, however, allow some shifting of the impeller to center it, the only adverse effect being a slight inequality of the length of the leakage paths on the two sides. An ingenious ring construction using axial clearances which overcomes this objection is illustrated in Fig. 2.

The ring design illustrated in Fig. 2 would have a higher first cost than the conventional radial-clearance ring designs. If it is to be adjustable after some of the wearing surface is eroded, the threaded parts must be made of a metal that is resistant to corrosion by the liquid being handled.

The foregoing discussion has involved leakage joints located immediately adjacent to the eye of the impeller, or at the smallest outside diameter of the shroud. There have been examples of construction in which the leakage joint has been located at the periphery of the impeller, as illustrated in Fig. 3. In a vertical pump this design has the advantage that the space between the joint and the suction waterways is open, so that sand or grit cannot collect. Besides having the disadvantages of increased area and of increased rubbing speed, this design would not be desirable for application in regular commercial pumps as the impeller diameters used in the same casing vary over a wide range.

The question naturally arises as to the advantage of providing a leakage joint both at the impeller eye and at the periphery. This construction has been used in a few sewage pump designs, with the basic idea of preventing solids from entering the space between the impeller and the suction or stuffing box head side walls. It cannot be used advantageously for high head pumps, as a set of rings at the periphery would increase the rotating surface. An increase in the rotating surface causes additional disc friction, offsetting any saving in reduced leakage loss that might result with the pair of leakage joints.

Mounting Stationary Rings

In small single-suction pumps which employ suction heads, a stationary wearing ring is usually pressed into a bore in the head; the ring may or may not be further locked by several set screws, located half in the head and half in the ring (this is illustrated in Part 4, Fig. 3). In larger pumps which employ suction heads, an "L" type ring with the flange held against a face on the head often is used as illustrated in Fig. 4. In such single-suction radially split pump designs having rings on the stuffing box sides, the stationary ring is generally of the "L" type, centered by a shoulder on the head and held in place by machine screws (as illustrated in Part 4, Fig. 10).

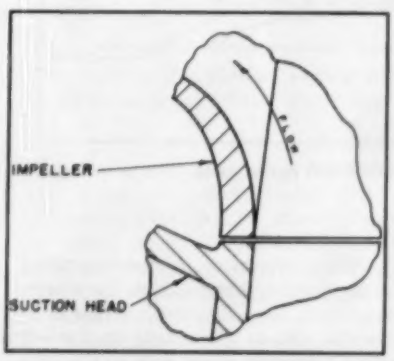


Fig. 1—AXIAL clearance leakage joint

Pressure Differential Prevents Leakage

In axially split case pumps, it is desirable that the cylindrical bore of the case (in which the casing ring is to be mounted) be slightly in excess of the outside diameter of the ring. Unless clearance is provided, some distortion of the ring may occur when one half casing is assembled on the other. It is necessary, however, to have a tight joint between the casing ring and the casing to prevent leakage through the stationary joint. In axially split case pumps, the tight joint usually is provided by a radial metal-to-metal joint (as illustrated in Part 4, Fig. 6), so arranged that the discharge pressure will press the ring against this surface of the casing.

Where the pressure differential across the leakage joint is very high, there have been cases of leakage through the casing—casing ring joint. Such leakage erodes the casing, and thus necessitates the use of a sealed casing ring design as shown in Fig. 6. The need for a seal of this type has been restricted primarily to multistage pumps with high stage pressures.

Methods to Prevent Torque

Since it is not desirable to have the

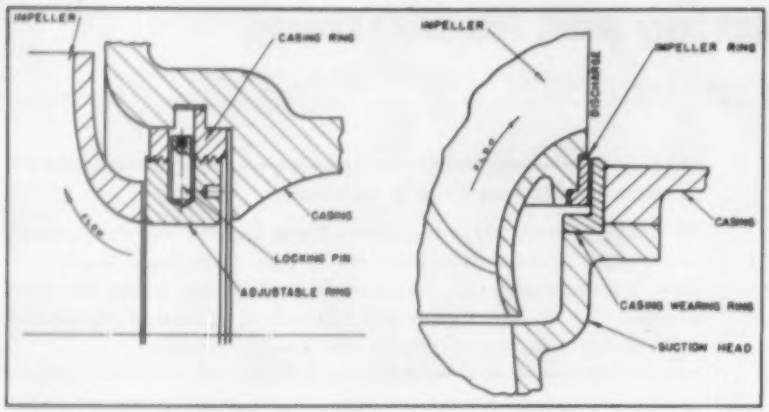


Fig. 2—ADJUSTABLE axial clearance leakage joint construction. Fig. 3—LEAKAGE joint located at periphery of impeller.

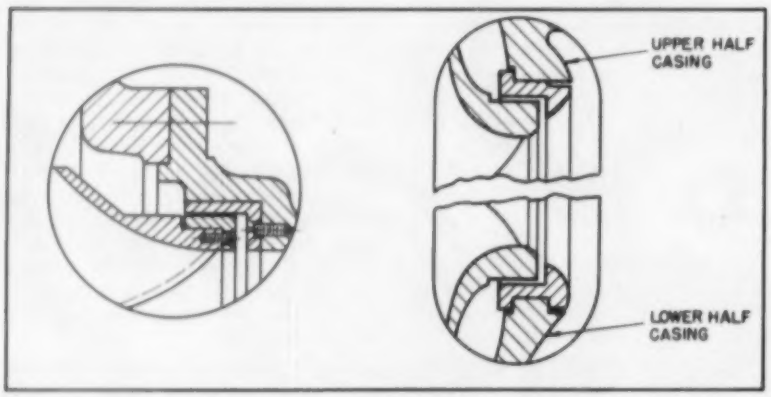


Fig. 4—DOUBLE RING construction; machine screws fasten rings to casing and impeller. Fig. 5—TONGUE-IN-GROOVE casing ring design.

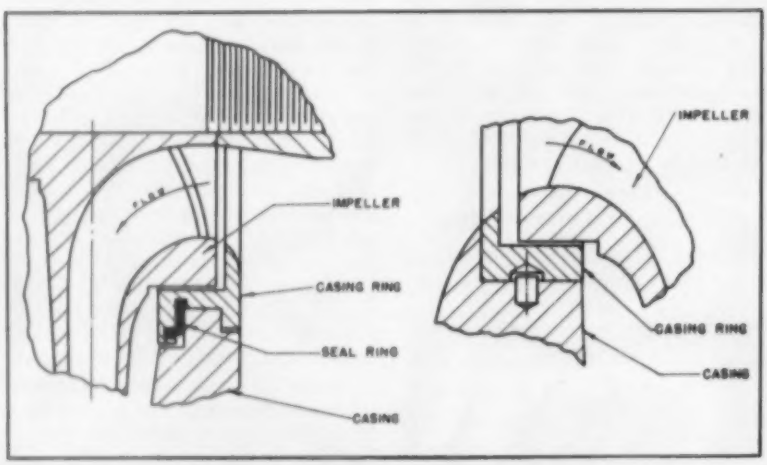


Fig. 6—SEALED casing ring design. Fig. 7—LOCKING device using "Pin in casing—hole in ring" design.

casing in an axially split casing design pinch the casing ring, provision must be made to prevent the casing ring from rotating; the rotation of the impeller will transmit a torque to the casing ring through the liquid in the clearance space. Numerous ways of preventing that rotation have been developed. One favorite method is to insert a pin in the casing to project into a larger diameter hole in the ring as in Fig. 7. Another method is to insert a pin in the ring to project into a larger diameter hole in the casing, or into a recess at the casing split joint.

Another favorite method used to prevent rotation is to provide a torque on the casing ring, extending around 180° and engaging a corresponding groove in one half of the casing, as illustrated in Fig. 5. This same method of locking the ring can be used with casing rings having a central flange (as in Fig. 2), by providing the 180° flange of larger diameter and by cutting a deeper groove in that half of the casing.

Holding Rings on the Impeller

There are many methods used for holding impeller rings on the impeller. Possibly the simplest method is to rely on a press fit of the ring on the impeller or, if the ring is of a suitable material, on a shrink fit. Designers usually do not put too much trust in a press fit; they prefer to use, in addition, several machine screws (Fig. 4) or set screws, located half in the ring and half in the impeller (illustrated in Part 4, Fig. 3).

Some designers prefer to thread the impeller and the ring, and to screw the ring onto the impeller (illustrated in Part 4, Fig. 8). Some even favor the use of right- and left-hand threads for the different sides, so that rotation will tend to tighten the ring on the impeller. Generally some locking device is used in addition, rather than relying solely on the friction grip of the ring on the impeller.

In the design of impeller rings, consideration must be given to the stretch of the ring due to centrifugal force, when the pump is of a high speed design for the capacity involved. For example, some boiler feed pumps operate at speeds which would cause the rings to become loose if only a press fit were used. In such cases shrunk fits should be used.

Maintaining Wearing Rings

As most pumps are equipped with a single flat type of wearing joint using a radial clearance, the following general discussion on maintenance will be based on that type. Specific comments on other types of wearing rings will be included later.

To restore the clearance between the impeller and casing, after wear occurs in pumps in which no ring is provided, the operator must: (1) buy new parts; (2) build up the worn surfaces by welding, metal spraying or other means; or (3) install a wearing ring or rings, providing sufficient metal is available either in the casing

part or on the impeller hub or both.

In pumps of a single stationary ring construction, considerable wear can be taken up on the impeller hub by progressively using underbored stationary rings. This is accomplished by first turning up the wearing ring hub of the impeller, and then by using stationary rings bored to give proper clearance with the new diameter of the wearing ring hub of the impeller. The underbored stationary ring could be a new part obtained from the manufacturer, or it could be the old ring with the wearing surface restored, by metal spraying or other means, and then bored to required diameter.

When double rings are involved, one renewal of the clearance can be made by reboring the stationary ring to a slightly larger diameter and replacing the impeller ring with a new one of larger outside diameter or building up the old ring by some means. By alternately renewing or rebuilding the rings, each ring can be used two or more times.

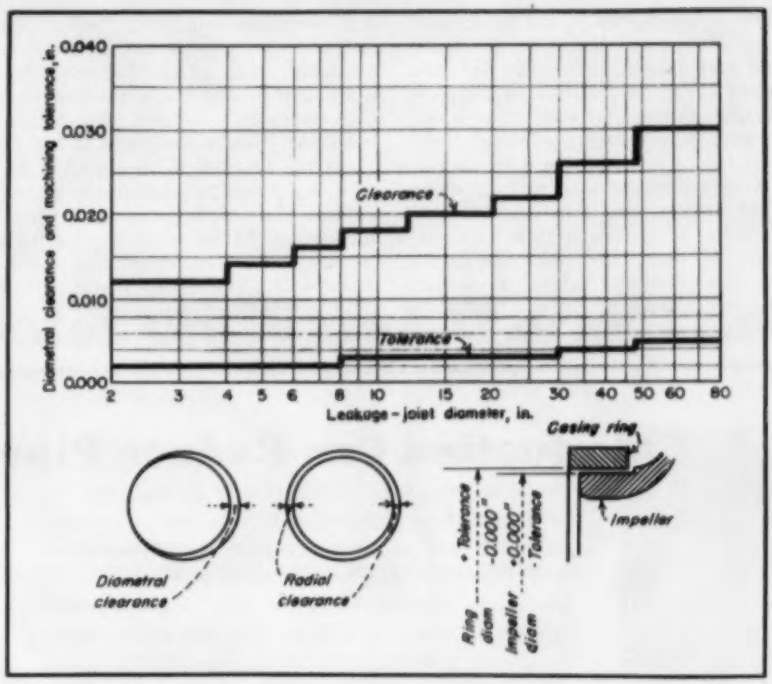


Fig. 8—CLEARANCE and TOLERANCE standards for wearing rings, single-stage pumps, when wearing joint materials are non-galling.

Specific Ring Maintenance Details

In wearing ring maintenance several questions arise. (1) Can impeller rings be mounted on an impeller and used without further machining? (2) What is the proper clearance between rings? (3) How much wear should be allowed before renewal? (4) How can the clearance be determined in designs such as that illustrated in Part 4, Fig. 6?

As for the first question: most impeller rings are now pressed on the impeller, and in this type of mounting there is always a danger that some distortion may result. It is advisable, therefore, after mounting the ring on the impeller to check the shaft and impeller assembly on centers to see if the new rings surfaces are true and, if not, to true them up. If facilities are available at the local plant to do this work completely, the simplest procedure will be to get slightly oversize rings from the manufacturer, and after mounting to turn the wearing surface to the proper diameter.

In answer to the second question: Fig. 8 shows one manufacturer's standard for clearances and tolerances for single stage general service type of pumps; these apply when the two metals making the wearing joint are non-galling, such as two dissimilar bronzes. When the metals involved gall easily, such as the chrome steels, these values should be increased by 0.002-in. While few readers of *Water and Sewage Works* have to deal with multistage pumps, it is interesting to note that in the case of pumps of 4 to 6 stages the basic clearance should be increased 0.002-in. on the diameter for rings up to 6-in. diameter, and 0.003-in. for rings over 6-in. Naturally, if the manufacturer's recommendation for the individual pump are known, their recommendation for ring clearance and tolerances should be followed.

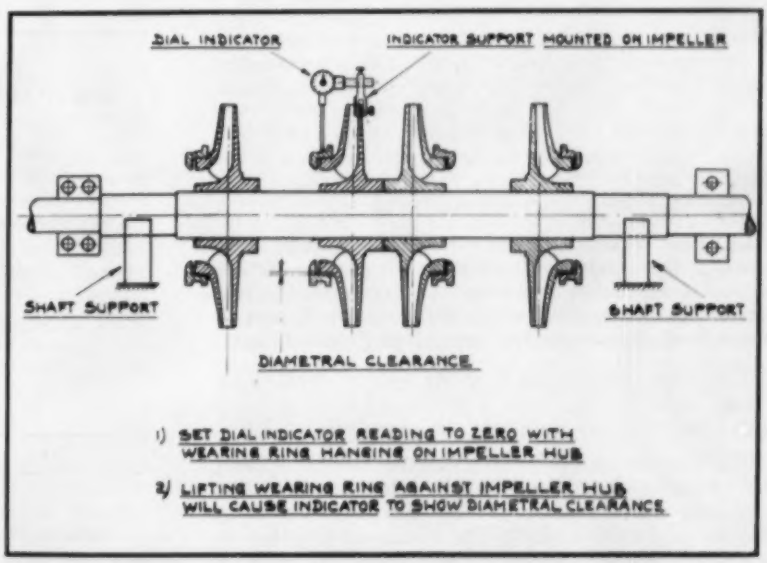

DIAL INDICATOR
INDICATOR SUPPORT MOUNTED ON IMPELLER
SHAFT SUPPORT
SHAFT SUPPORT
DIAMETRAL CLEARANCE
1) SET DIAL INDICATOR READING TO ZERO WITH WEARING RING HANGING ON IMPELLER HUB
2) LIFTING WEARING RING AGAINST IMPELLER HUB WILL CAUSE INDICATOR TO SHOW DIAMETRAL CLEARANCE

Fig. 9—DIAL INDICATOR method utilized for measuring wearing ring clearance on a multistage pump without dismantling the pump rotor.

Wear Allowance Before Renewal

As to how much wear should be allowed before a pump is dismantled and the wearing joint renewed: it is difficult to make a general answer to this question as too many factors are involved. Internal leakage through rings naturally means a loss in efficiency, and ring renewal should be such that "down-time" and other

costs will be offset by the power savings. Thus, with constant pump use and high power costs, more frequent renewal can be justified than can be justified for pumps used infrequently or when power costs are low. A rough rule might be taken as a guide that 100 per cent increase in ring clearance justifies ring renewal.

With "L" or nozzle type stationary wearing rings, the clearance cannot be measured by feelers; even with single stage pumps in which the stationary rings can be renewed easily, it is not often feasible to "mike" the surfaces easily. If a dial indicator is available, the set-up followed for multistage pumps can be utilized to get the clearances without dismantling the rotor. This is illustrated in Fig. 9.

As for rings of other than the flat type, maintenance procedures should follow the manufacturer's recommendation. In the example of a joint having axial clearance such as in Fig. 1, the individual design might permit altering the stationary part, or the impeller, or both parts, to accommodate a ring or rings. In case of labyrinth rings (illustrated in Part 4, Figs. 7 and 8) the complicated form of the ring generally does not permit either building up the worn surfaces, or even utilizing one part by remachining. As a result replacement of both rings is advisory.

This is the second and concluding installment in the discussion of wearing rings.

W&SW

Chlorination Can Reduce Pipe Line Friction

A report on experience using intermittent chlorine treatment

by JOHN A. FULKMAN, Consulting Engineer
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THIS is a summary report of tests conducted to determine friction loss of head in two new water supply pipe lines, before and after chlorine treatment of the water. One of these pipe lines carries raw water from the DesPlaines River, and the other line carries water from the Kankakee River. Tests were made in March, 1953, before chlorine treatment, and in December, 1953, after chlorine treatment.

Chlorination of the water was started in June 1953 and has been continuous to the present time. Intermittent chlorination has been found successful. The rate of chlorine application is approximately 50 pounds per million gallons for 7 minutes during each 2 hours.

The water supply pipe lines are welded steel, 42-in. inside diameter, and have a bituminastic lining. The pipe lines have been in service for more than ten years.

The DesPlaines River carries treated sewage effluent and drainage from the Chicago area. The pipe line supplying water from this river is 11,817 feet long, and includes several bends. The results of tests before and after chlorine treatment are reported in Table 1.

The second pipe line carries raw water from the Kankakee River. This river flows through a rather densely-populated area in Northern Indiana and Illinois, and is used for the public water supply of the City of Kankakee, Illinois. The pipe line on which tests were made is 20,278 feet long. The pipe line supplies water for use at a defense plant, and therefore the identity is not given. The results of tests before and after chlorine treatment of the second pipe line are given in Table 2.

W&SW

TABLE 1
Data on Pipe Lines Carrying DesPlaines River Water

Flow Gallons Per Minute	Loss of Head in Feet	Loss of Head Feet Per 1000 Feet of Pipeline	Approx. "C" Value (Williams & Hazen)
(Determinations in March, 1953, Before Chlorine Treatment)			
25900	53	4.48	92
13200	15	1.27	93
20800	37	3.13	92
(Determinations in December, 1953, After Chlorine Treatment)			
27000	30	2.54	130
15000	10	0.85	130
20700	18	1.52	130

TABLE 2
Data on Pipe Lines Carrying Kankakee River Water

Flow Gallons Per Minute	Loss of Head in Feet	Loss of Head Feet Per 1000 Feet of Pipeline	Approx. "C" Value (Williams & Hazen)
(Determinations in March, 1953, Before Chlorine Treatment)			
14700	23	1.14	111
20300	40	1.97	111
24400	59	2.91	111
(Determinations in December, 1953, After Chlorine Treatment)			
18000	27	1.33	125
20000	33	1.62	125
24400	47	2.30	125

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Notes on Water Works Law

by JOHN H. MURDOCH, JR.

Mr. Murdoch is Vice-President of American Water Works Co., Inc., and Vice-President and Counsel of American Water Works Service Co., Inc., Philadelphia, Pa. He has prepared exclusively for *Water & Sewage Works* this series of articles discussing water works law as it applies to source of supply, water quality, and water distribution.

Third Installment—Pollution and Public Water Supplies

THIS section of the "Notes on Water Works Law" will be devoted to stream pollution. Here again riparian right must be considered. As has been shown, the owner of riparian lands has rights in the quantity of flow. He also has the right to have the waters of the stream come down to him unimpaired in quality. Again each riparian owner's rights are, in a sense, limited by the rights of other riparian owners. Since each has the right to have the quality of the water reaching his land unimpaired it necessarily follows that no upstream owner has the right to impair the quality of the water leaving his land. This limitation of right, or reciprocal duty, is important because much of the force of modern clean stream legislation is derived from it. It need hardly be mentioned but the absence of right to pollute water is not confined to riparian owners. Clearly waters could be, and often are, polluted by persons who do not own riparian lands. Industrial wastes, sewage, refuse or mine drainage, are often carried to streams by communities or persons having absolutely no riparian rights in the stream. The riparian owner does have the right to make reasonable use of the stream as it flows past his land and he may, through such reasonable use, somewhat impair the quality of the water. So long as that impairment is brought about by non-negligent exercise of his right to reasonable use, he is within his rights. Certainly the non-riparian pollutor has no such riparian right and it is very questionable if he could have property rights to impair the quality of the waters of a stream of as high an order as those of a riparian owner.

In all that has been said here it is assumed that property rights or right to pollute have not been created by grant or prescription.

The law concerning stream pollution has developed and changed with changes in conditions of life. Those conditions of life have changed drastically and are continuing to change in regard to flowing waters. The writer can remember as a boy listening to his father and grandfather tell of fishing and swimming in streams which he knew well. He listened to these stories of their younger days in wonder and regret and, it must be admitted, with a great amount of respectful, but unexpressed, incredulity. Those streams which they pictured as beautiful and healthful, he knew only as ugly, foul open sewers. Between the boyhoods of the generations the industrial revolution had reached the community. Until recently domestic and urban sanitation was—by modern standards—crude and offensive and contributed to stream pollution. But our urban centers were few and small considered with relation to the extent of the land and their burden of sewage contributed to the streams was not beyond the capacity of the streams to digest in a few miles. In rural districts people lived far enough apart so that their domestic habits did not seem to impose burdens on others. Large industrial establishments and mines were few and their effects on the streams were localized.

It must also be remembered that advancing knowledge of the evil effects of stream pollution has opened our eyes to dangers which were not formerly recognized as such. Stream pollution which we now know led to typhoid was tolerated because the connection between the pollution and the disease was unknown. Bad conditions were also tolerated by the people and condoned at law because no one knew how to correct them. Without the guidance of the sanitary engineers society today would have to choose between industrial stagnation and

Author's Review

In the first two installments of these notes, the law relative to riparian rights regarding upstream diversions has been touched upon. The general statement has been made that the owner of riparian lands has the property right to have the waters of the stream to which his lands are riparian reach his riparian lands undiminished in quantity except as the flow is diminished by reasonable uses on upper riparian lands. It has been shown that "reasonable uses" cannot be accurately defined but that uses must be judged as to reasonableness by the facts in each case. The law regarding use of water for the irrigation of riparian lands has been discussed with some comments on the laws of our western states.

a population decimated by disease. The law has had to keep in adjustment with these changes in the life of the nation. The basic legal principles regarding riparian rights and flowing waters were never given up but in application exceptions were made in recognition of what were assumed to be realities or the overriding needs of the people.

For many years coal mining has been a major industry in Pennsylvania. No one has yet been able to find a way in which coal can be mined economically without serious impairment of the quality of the water downstream from the point of discharge of water from the mine. Within recent years much intensive study has been given to the problem but so far no solution has been found. With that background it is interesting to follow the development of the Pennsylvania law regarding coal mine stream pollution.

The Supreme court of Pennsylvania, on May 6, 1878 handed down its first of a series of three decisions concerning a controversy between Sanderson and The Pennsylvania Coal Company. This first decision is reported in 86 Pa. 401. The facts can be briefly stated. Sanderson and his wife bought land on Meadow Brook in Luzerne County, Pennsylvania, and erected a residence on the land in 1868. Meadow Brook at the time was a stream of pure water and the Sandersons used the water for domestic purposes and for a fish pond. Later, The Pennsylvania Coal Company began mining operations above the Sanderson land and mine drainage polluted the stream, killed the fish in the pond, corroded pipes and rendered the water unfit for domestic use. The Sandersons brought an action for damages and the Luzerne County court granted a nonsuit on the ground that there had been no showing that the mining company had been negligent or had acted with malice. On appeal to the Pennsylvania Supreme Court the lower court was reversed and the case was sent back for a new trial to permit the jury to pass on the question of whether the Sandersons had been damaged.

In this case the Supreme Court followed the English Common Law rule that a man has no right to so use his own property, that the use results in injury to his neighbors. The opinion recognizes the right of lower riparian owners to receive the water in a natural surface stream undiminished in quantity and unimpaired in quality.

In the course of the opinion the court made these points: (1) the invasion of an established right will in general per se constitute an injury for which damages are recoverable, for in all civil acts the intent of the actor is less regarded than the consequences to the party suffering; (2) however laudable industry may be, its managers are still subject to the rule that their property cannot be so used as to inflict injury on the property of others; (3) to render a particular case an exception to the general principles controlling the exercise of dominion over property, by its proprietor, it must be ascertained to be exceptional in its surroundings or its facts, otherwise the duty of the owner of property is defined by the maxim, *Sic utere tuo ut alienum non laedas*. The court took notice of the argument of the mining company that a holding that a mine owner had no right to dump mine waste in a stream would seriously cripple an important industry. The court then observed that where such a result would follow, the courts should not award damages or restrain trivial and inconsequential interferences.

On the retrial of the Sanderson case the mining company offered proof of a custom for mining companies to pollute streams with waste. The lower court rejected this offer of proof and the jury awarded Sanderson $250 damages. The case was once more appealed by the company and the Supreme Court this time sustained the lower court. The decision is reported in 94 Pa. 302 and was handed down May 3, 1880. The appeal court held in its opinion that the Sandersons had as much of an absolute right to the use of uncontaminated water of the brook as they had in the land itself. It was also held that the fact that coal mining is an important industry would not relieve the mining company of liability and that the custom referred to would not justify its action.

The same parties were in the courts again in 1885 and 1886 and this time when the case reached the state Supreme Court the mining company won and the previous opinions in the two earlier cases were overruled. Four of the justices who decided the last case had been on the court in the first case, one had been on the court for the second case, and two new justices appear who had not been on either of the other cases. Chief Justice Sharswood sat on the first case but was not a member when the other cases came up. This indicates that justices changed their minds between 1878 and 1886.

This last Sanderson case is reported in 113 Pa. 126, the opinion being handed down October 4, 1886. The court held: (1) Damages resulting to another from the natural and lawful use of his land by the owner thereof are, in the absence of malice or negligence, are damages for which no legal action will lie; (2) one operating a coal mine in the ordinary and usual manner may upon his own lands drain or pump the water which percolates into his mine into a stream which forms the natural drainage of the basin in which the mine is situate, although the quantity of the water may thereby be increased and its quality so affected as to render it totally unfit for domestic purposes by the lower riparian owners; (3) the use and enjoyment of a stream of pure water for domestic purposes by the lower riparian owners who purchased their land, built their houses and laid out their grounds before the opening of the coal mine, the acidulated waters from which rendered the stream entirely useless for domestic purposes, must of necessity give way to the interests of the community, in order to permit the development of the natural resources

of the country and to make possible the prosecution of the lawful business of coal mining. On page 145 of 113 Pa. this is found: "It will be observed that the defendants have done nothing to change the character of the water, or to diminish its purity, save what results from the natural use and enjoyment of their own property. * * * It must be conceded, we think, that every man is entitled to the ordinary and natural use and enjoyment of his property; * * . If in the excavation of his land, he should uncover a spring of water, salt or fresh, acidulated or sweet, he will certainly not be obliged to cover it again, or to conduct it out of its course, lest the stream, in its natural flow, may reach his neighbor's land." From page 155—"the law has never gone so far as to recognize in one man the right to convert another's farm to his own use as a filter."

The Sanderson case is famous and has given the courts of Pennsylvania and of other states, to say nothing of practicing lawyers, many hours of labor and endless trouble. The result in Pennsylvania was the unhampered development of the mines—that is, the development was unhampered by claims for damages for injuries to private lower riparian owners. In its home state it has been explained and its application limited especially as regards pollution of sources of public water supply as will be shown later. In other states the courts have been very slow to follow Sanderson as good law and in some instances it has been condemned as bad law. Yet it is a fact that in some other states industry and mines have polluted streams without the payment of damages. Perhaps the people accepted the disadvantages of industrial development as a small or reasonable price to pay for the development of natural resources and did not appeal to the courts. It should be noted that Sanderson did not hold that the lower riparian owner did not have a property right in an uncontaminated flow. The effect of the decision probably was a holding that coal mining with its unavoidable evil results downstream was a reasonable use of the upstream owners' land. In other words, the decision did not set aside the principles of the law of riparian rights but gave a new concept to the principle of that law regarding "reasonable use."

The case of *Collins v. Chartiers Valley Gas Co.*, 139 Pa. 111, opinion January 5, 1891, held that one who injures his neighbor's water well by neglecting to adopt reasonable precautions in casing a gas well is liable for damages. Here protective precautions could be taken, in coal mining there was no known method of preventing the pollution. This is a limitation of the effect of Sanderson.

In the case of *Pfeiffer v. Brown*, 165 Pa. 267, opinion January 7, 1895, the action was for damages by the owner of land overflowed with salt water from oil wells of the defendant. The lower court gave judgment for the defendant on the grounds that the damage resulted from the natural use of the defendant's land and that he had not acted negligently or with malice and that the damage could not have been avoided by slight or small expense. On appeal the Pennsylvania Supreme Court reversed the lower court. The appeal court held that if the defendant could have avoided inflicting the damage by reasonable care and expenditure, he would be liable. It held also that if the expense of preventing the damage would practically counterbalance the expected profit the expense would be unreasonable. If, on the other hand, the expense though large in amount is small in proportion to the expected profit, the preventive measures should be taken. This is another limitation of the Sanderson doctrine.

A public water supply was directly involved in the case of Commonwealth ex rel. and The Butler Water Company v. Russell, et al., 172 Pa. 506. The opinion of the Pennsylvania Supreme Court was handed down on January 6, 1896. The defendants operated oil wells which produced oil and salt water, the salt water being from 95% to 98% of the amount pumped. This salt water was allowed to flow into the streams on the watershed above the water company's impounding reservoir. The Commonwealth and the water company sought an injunction to restrain the defendants from polluting the public water supply. The lower court refused to issue the injunction on the authority of the Sanderson decision. The Supreme Court reversed the lower court and sent the case back to have the matter fully heard on its facts. It stated that three questions were involved: (1) To what extent does the public use served by the water company place it on higher ground than that of a private person or corporation serving a private use?; (2) does a city with its thousands of inhabitants, and its duty to protect them in the enjoyment of the necessities of life and the preservation of health, stand on no higher ground than a private citizen so far as the protection of its water supply from pollution is concerned?; (3) may not the Commonwealth rightfully interfere in such a case in the exercise of its police power? The court distinguished Sanderson on the ground that in that case the court had dealt with a situation where a private person had sought to enjoin the lawful use of property of an upper riparian owner while in this case the lower owner represented the interest of the general public. The court asked—page 521 of 172 Pa.—whether "the Commonwealth in the exercise of its police power may not limit and restrict the individual in the exercise of admitted rights, when the welfare of the public requires it; or whether it is indeed true that ownership of a few acres of land, or a leasehold interest therein, gives to the holder an unqualified right to destroy the water supply of a city in the effort to develop some subterranean value in her land." The tone of the questions indicates the thought of the court and the extent to which the effect of the Sanderson case doctrine was being limited.

In *McCune v. Pittsburgh and Baltimore Coal Company*, 238 Pa. 83, opinion January 6, 1913, the Sanderson doctrine was still further limited, this time for a private plaintiff. Here the mining company pumped water from a mine, when the water was diverted from its natural outlet which was not to the stream on which McCune had his riparian land. The Supreme Court affirmed on the opinion of the lower court which had said: "If the doctrine of the Sanderson case is not to be extended, as we are admonished by the Supreme Court, it is clear that we have no right to give it application here. * * * The undoubted tendency of the later cases is to limit rather than extend the principle of that case. It follows, therefore, that the defendant must use its own property so as to avoid injury to the plaintiff."

The next Pennsylvania case to be discussed was a battle of giants. On one side there were the Commonwealth, the Pennsylvania Railroad and its subsidiary Mountain Water Supply Company and Westmoreland Water Company. The latter company was a privately owned public water supply company serving a number of large municipalities in Westmoreland County, Pennsylvania. On the other side were a number of coal com-

panies backed by very powerful financial interests. Relying on the Sanderson doctrine the coal companies were developing mines in the Indian Creek Valley in the general region of Uniontown, Connellsville, and Greensburg and were polluting the waters of that creek which waters were used to supply the railroad and the communities served by Westmoreland Water Comany. The opinion in the case was handed down September 29, 1924—*Pennsylvania R. R., et al. v. Sagamore Coal Company*, 281 Pa. 233 (Cert. denied 267 U. S. 592). The railroad and its allies sought an injunction to enjoin the coal companies from polluting Indian Creek. The lower court dismissed the bill on the authority of the Sanderson case and on the additional ground that the right to drain a mine was a property right which could not be taken away without the payment of just compensation. On appeal the decision was reversed.

In the Syllabus appear the following points among others: (2) Riparian owners have no such property right in a stream as to give them the right to pollute it with refuse from mines to the detriment of the public * * ; (3) a landowner on a water course, whose rights are only those of a riparian proprietor, cannot have such rights enlarged to one of property in the use of water, by the discovery or development of coal on his land; (5) it is a nuisance to pollute a stream from which the public gets its supply of water; (14) upper riparian owners are deprived of nothing by the appropriation of the water below them, and are therefore not entitled to damages from a water company appropriating such water.

The principles set forth in these four sections of the Syllabus in this case are of vital importance to water works operators. They should never be forgotten. And students should not overlook the point that the legal principles set forth by the Pennsylvania Court while in terms referring to coal mine pollution are equally applicable to all pollution. In view of the Sanderson case the court here was demolishing the strongest point of defense for any pollutor.

Referring to the Sanderson case, the Supreme Court is reported to have written—281 Pa. at 246—"No language used in that opinion can be tortured into an implication that the waters of the Commonwealth can be polluted by its mines where the public is affected as it is here. It has always been under our law a nuisance to pollute a stream from which the public gets its supply of water." Again from page 248 of the report: "We come to the consideration of the conclusion of the trial judge that the right to drain the mine water into the stream is a property right. To reach this determination, he gave the Sanderson case a much broader effect than it has ever before been given and overlooked how limited has been its application. It is somewhat difficult to understand why he badged the draining of the mine water into the stream as a 'property right' in the defendants of which they cannot be deprived except upon payment being made to them. Nothing said in the Sanderson opinion warrants such a conclusion even from the standpoint of the private right involved, and certainly not where public rights are at stake. * * * The most that could be said of what was accorded the defendant in that much controverted case is that it was a privilege. There could be no such thing in the law as a property right to do a wrong, * * ."

Primary attention has been given here to this line of

Pennsylvania cases because of the widespread criticism of the first case in the line—Sanderson—and because the author wishes to show that the case does not have the wide implications which some have feared. That case appears to have been the most widely discussed case which appeared to set aside the common law of riparian rights. Yet the net result of these Pennsylvania cases is to leave that basic common law unimpaired except to the extent of recognizing the *unavoidable* pollution stemming from the exercise of a lawful business as the result of a "reasonable use."

A case in New Jersey in 1903 is interesting as showing the accommodation of the law to supposed realities. In *Doremus v. City of Paterson*, 65 N.J. Eq. 711 downstream owners of riparian properties sought an injunction to have the city restrained from polluting the Passaic River with sewage. In an earlier case, *Simmons v. Paterson*, 15 Dick. Ch. Rep. 385, the right of a riparian property owner, above tidewater, to an injunction restraining pollution of the river had been affirmed. In the Doremus case some parties were improperly joined and on that ground a demurrer was sustained. However, for some reason, the court went on to hold that while the riparian owners had property rights they held those rights subordinate to the city's right to vent sewage into the stream. This is hard to understand. Perhaps sewage disposal by treatment plants was impossible, but it is doubted whether that was true in 1903. Perhaps, the New Jersey court had read the Sanderson case. The result should be different under modern conditions.

The New York case of *Strobel v. Kerr Salt Company*, 58 N.W. 142, opinion October 2, 1900 is of great interest. In that case the New York Court of Appeals held to the strict common law doctrine of riparian rights, and passed on the troublesome situation where a number of persons contribute small amounts of pollution, producing a total which is objectionable even though no one individual contributed an individually objectionable amount of pollution.

Facts: The Salt Company owning riparian lands diverted water from Oatka Creek for use in bringing salt to the surface from underground beds and in purifying the salt. Part of the water was evaporated in the process of purifying the salt. Other water containing salt was returned to the stream and rendered it so salty as to make it unfit for use by lower riparian

owners. Cattle refused to drink water in the stream except when nothing else was available, and the water was unfit for boiler use. The Kerr Salt Company was only one of a number of companies contributing to the condition. The lower riparian owners sought an injunction which was refused by the Supreme Court and by the Appellate Division of the Fourth Department, one Judge dissenting.

The Court of Appeals reversed the judgment of the Courts below and granted a new trial.

Extracts from the Opinion: (The Court referred to the cases of Coal Company v. Sanderson in Pennsylvania and found those decisions to be unsound so far as New York was concerned.)

"The Court below, however, manifestly followed the Pennsylvania rule without limitation. * * * * We have never adopted that rule in this State and no public necessity exists therefor, even if it would ever warrant the Courts in relaxing rules for the protection of property of small value in the interest of some business required to develop the resources of the state, and in which much capital had embarked, giving employment to a great number of people.

"There is nothing about the case now before us to take it out of the general rules governing the rights of riparian owners. Those rules are well established in this state, and, so far as material to the case before us, are, in the absence of modification by grant or prescription, as follows: A riparian owner is entitled to a reasonable use of the water flowing by his premises in a natural stream, as an incident to his ownership of the soil, and to have it transmitted to him without sensible alteration in quality or unreasonable diminution in quantity. While he does not own the running water, he has the right to a reasonable use of it as it passes by his land. All other owners upon the same stream have the same right, the right of no one is absolute, but is qualified by the right of the others to have the stream substantially preserved in its natural size, flow, and purity, and to protection against material diversion or pollution. This is the common right of all, which must not be interfered with by any. The use by each must therefore be consistent with the rights of the others, and the maxim of "Sic utero tuo" observed by all. The rule of the ancient common law is still in force: 'Aqua currit et debet currere ut currere solebat.' Consumption by watering cattle, temporary detention by dams in order to run machinery, irrigation, when not out of proportion to the size of the stream, and some other familiar uses, although in fact a diversion of the water involving some loss, are not regarded as an unlawful diversion, but are allowed as a necessary incident to the use, in order to effect the highest average benefit to all the riparian owners. As the enjoyment of each must be according to his opportunity, and the upper owner has the first chance, the lower owners must submit to such loss as is caused by reasonable use. Surrounding circumstances, such as the size and velocity of the stream, the usage of the country, the extent of the injury, convenience in doing business, and the indispensable public necessity of cities and villages for drainage, are also taken into consideration, so that a use which, under certain circumstances, is held reasonable, under different circumstances would be held unreasonable. * * * *

"The question of reasonable use is generally a question of fact, but whether the undisputed facts, and the necessary inferences therefrom, establish an unreasonable use, is a question of law. When the diversion, or pollution, which is treated as a form of diversion, is caused by a new and extraordinary method of using the water, hitherto unknown in the state, and such method not only permanently diverts a large quantity of water from the stream, but also renders the rest so salt, at times, that cattle will not drink it unless forced to by necessity, fish are destroyed in great numbers, vegetation is killed, and machinery rusted, such use, as a matter of law, is unreasonable and entitles the lower riparian owner to relief. Where the natural and necessary result of the place selected, and the method adopted by an upper riparian owner in the conduct of his business, is to cause material injury to the property of an owner below, a court of equity will exercise its power to restrain, on account of the inadequacy of the remedy at law, and in order to prevent a multiplicity of suits. The lower riparian owners are entitled to a fair participation in the use of the water, and their rights cannot be cut down by the convenience or necessity of the defendant's business. 'The necessities of one man's business cannot be the standard of another's rights in a thing which belongs to both.' *Wheatley v. Chrisman*, 24 Pa. St. 298. While the courts will not overlook the needs of important manufacturing interests, nor hamper them for trifling causes, they will not permit substantial injury to neighboring property, with a small but long-established business, for the purpose of enabling a new and great industry to flourish. They will not change the law relating to the ownership and use of property in order to accommodate a great business enterprise. According to the old and familiar rule, every man must so use his own property as not to injure that of his neighbor; and the fact that he has invested much money and employs many men in carrying on a lawful and useful business upon his own land does not change the rule, nor permit him to permanently prevent a material portion of the water of a natural stream from flowing over the land of a lower riparian owner, or to so pollute the rest of the stream as to render it unfit for ordinary use. The fact that other salt manufacturers are doing the same thing as the defendant, instead of preventing relief, may require it. 'Where there is a large number of persons mining on a small stream, if each should deteriorate the water a little, although the injury from the act of one might be small, the combined result of the acts of all might render the water utterly unfit for further use; and, if each could successfully defend an action on the ground that his act alone did not materially affect the water, the prior appropriator might be deprived of its use, and at the same time be without a remedy.' *Hill v. Smith*, 32 Cal. 166. * * * * ."

W&SW

(The third in a series of articles)

Proceedings Of Pollution Symposium From Louisiana State University

As Engineering Expt. Station Bulletin No. 43, The Proceedings of the Third Annual Water Symposium on Water Pollution have been made available by the College of Engineering of Louisiana State University, Baton Rouge, La. Seven of the eight papers presented at that symposium are reproduced in full. A charge of $.50 per copy is made for this 46-page bulletin.

Maine Water Utilities Assn's 29th Annual Meeting in Portland

Host and Head Table
P.W.D. President, "Ed" Boulos makes welcome address. On his left Trustees McLellan and Jordan

THE Portland Water District for the 29th year was again host to the Maine Water Utilities Association on February 8th and 9th.

The meetings were held in the attractive, adequate and spic and span Service Building of the Portland Water District. A record number of exhibits of manufacturers and manufacturers agents were arranged in the amply spacious P.W.D. garage adjoining the Service Building. Any person or firm supporting the Journal of the M.W.U.A. with advertising is eligible to exhibit without a charge of any kind. The District provides the collapsible tables, built for the purpose, and signs showing the identity of the company. The exhibitor does the rest. This feature of the Annual Portland Meeting draws larger and larger attendance each year. The afternoon of the first day and forenoon of the second are devoted to inspection of exhibits, shop talk, equipment demonstrations, doughnuts and coffee, and just plain chit-chat.

P.W.D.'s Evening

The evening of the first day is P.W.D.'s Evening. As hosts the employees of the District prepare and serve a real Down Maine Clam Chowder Supper, with trimmings. The white chowder is always excellent—the Portland doughnuts (made with good Sebago Lake water) even more delectable. This reporter never has any room for the pie, cheese and ice cream.

After supper, while puffing on P.W.D.'s "seegars," members and guests (that includes the peddlers, politicians and editors) hear a short welcoming address by P.W.D.'s president, "Ed." Boulos, and a report on the year's "Activities of P.W.D." by Chief Engr., Genl. Manager, and Treasurer, Herman Burgi, Jr.

Interesting, as always, Mr. Burgi's report this year related the first year's experience with the new machine (stub) billing in conjunction with cycle billing, the costs of main relocation incident to state highway construction, strengthened feeder mains and a difficult river crossing installation in which rugged 30" "Molox" ball-joint pipe was employed. The cost of $57.00 per foot for the 30" pipe, as received, indicates that river crossings are expensive. This pipe weighs 4 tons per length.

The two hurricanes and a generally wet summer cost P.W.D. at least a $44,000 loss in water sales to residential customers for sprinkling, and a total loss of $55,000 due to the "rainy season."

The six hour hurricane "Edna" on Sept. 11th dumped almost 8" of water into Sebago Lake Reservoir in the six hours. During the succeeding 36 hours the level was upped another 12", representing run-off, and the lake was then brim full of water for all-gravity delivery.

Experiences with the machine billing and cycle billing introduced Jan. 1, 1954, had passed all expectations. With the machine stub plan of billing the records are so easily checked that the annual audit required but a total of six man-hours. This year, as contrasted with the required 80 man-hours for checking the old ledger system. The stub plan has made delinquency so readily identified as to have resulted in less than 0.05% non-collected billings. The 5% discount for prompt payment of quarterly bills had been discontinued.

Relocation of mains necessitated by highway relocation and new highways and turnpike has cost P.W.D. $175,421 without adding any appreciable value to the system. In addition to this non-compensated main relocation work, $125,000 relocation work had been compensated by the Maine Turnpike Authority. At present there is a bill in the Maine legislature which is designed to bring relief to cities and utilities saddled with main-relocation expense.

Mr. Burgi then highlighted the several projects, involving 36, 42 and 48 inch feeder mains to outlying sections in the District where greatest industrial or residential growth is expected. Increased pressures of two to five lbs., resulting from the larger feeder lines, had apparently been responsible for old main ruptures and joint leakage—so it is a question of taking some bad with the good.

The President
Francis L. Hatch
Supt.
Kittery, Me.

Past President
Leander G. Smith
Supt.
Kennebunk, Me.

Editor
Sidney S. Anthony
Supt.
Augusta, Me.

Sec'y-Treas.
Earle A. Tarr
Supt.
Winthrop, Me.

Committee Reports

THE LEGISLATIVE COMMITTEE (H. Burgi, Chmn.) reported through Edw. Gignou, City Atty. for Port-

Exhibits

Meeting Work Horses

C. P. Renell
P.W.D. Foreman

D. F. Potter
P.W.D. Maintenance

Exhibits

land and Committee Counsel, that M.W.V.A. would not press for removal of the State Sales Tax from water bills. The savings to water users was not sufficient to make an issue of it, whereas the State would be losing $60,000 in tax revenue. The Governor is, however, recommending exemption of water service charges from the Sales Tax.

In the next Legislature a bill is being introduced to prohibit water fluoridation in Maine. Maine law already requires that before a water utility can introduce fluoridation the people must be given opportunity to work for or against it. Another new bill requires that taxes be paid on property of all Water Districts. The most important bills being backed by M.W.V.A. are those calling for compensation by the State to all utilities put to the expense of main on conduit relocation incident to highway construction or highway widening.

THE AIR CONDITIONING COMMITTEE (Geo. S. Wescott, chmn.) reported that replies to 80 questionnaires recorded that water demand for air conditioning is not of such importance in Maine as it was thought to be. Mr. Wescott, for the committee, recommended that members familiarize themselves with the A.W.W.A. Model Ordinance for use in holding in check water waste in refrigeration and air conditioning installations before such becomes a real problem. This ordinance appeared in the A.W.W.A. Journal for December 1950. Reprints are available.

Free Dinner To Curry

At this point it was announced that the free dinner to the members travelling the greatest distance to the meeting had been won by Ken Curry from Caribou.

Host
Herman Burgi, Jr.
Treas. & Gen'l Mgr.
P.W.D.

Principal Speaker
Rolf Eliassen
Prof. Sanitary Eng.
M.I.T.

Director
J. Elliott Hale
Supt.
Waterville, Me.

Program Chairman
John P. Hennings
Supt.
P.W.D.

Radio-activity in Water Supply Featured Topic on Program

"THE IMPACT OF RADIO-ACTIVITY ON WATER SUPPLY" was discussed as the featured topic by Prof. Rolf Eliassen of the Mass. Inst. of Technology. In his very lucid explanation of nuclear energy he stated that in producing such energy alpha, beta and gamma radiation must be coped with. The first two are stopped rather easily but the really dangerous rays are the gamma rays, which will require a lead sheet 5 centimeters (2 in.) thick to stop these lethal rays. The tremenduous speed of travel of radioactive particles is the important factors. How the Geiger Counter picks up, and indicates the degree of radioactivity was explained.

At present there are 20 atomic power reactors in the U. S. The future problem is what to do with the waste from such reactors. While treatment studies are being made the wastes are being stored in undeground tanks. There is no known way of destroying radioactivity. If a water supply reservoir becomes dangerously radio-active the only solution is to provide an auxiliary supply. After 3 months the vitiated reservoir may be safe for use again.

As to water treatment for removal of radioisotopes, studies record that certain type of floc will pull down radio-active substances to below the danger point. It may be that water treatment plants and processes will have to be modified to cope with radio-active contaminants.

Prof. Eliasson pointed out that the present concern of water supply authorities is the "fall-out" contamination which results from atomic blasts. This fall-out comprises radio-active dust or precipitation which comes back to earth after its ascent at the point of the bomb-blast. Travelling thousands of miles from Nevada to the Atlantic Ocean, Kodak films at Rochester, N. Y. have been ruined by radio-active dust and water supply. Some American fall-out actually come all the way from Russia. Radio-active strontium is the worse offender in regards travel characteristics.

Answering questions, Prof. Eliassen said that only 21 U. S. cities are studying methods for radio-activity removal from water. Ordinary filtration practice removes 30 to 70% of radio-activity. The excess lime treatment in softening removes 90% or more of the radio-active strontium.

As to the affect of fall-out on ground-water supplies, Prof. Eliassen stated that no vitiation of ground water had been reported. Therefore, until there was evidence to the contrary, ground water supplies are the safest against radio active fall-out.

W&SW

Limiting Entering Head, or How Much a Pump Can Pump

by R. A. MILLER

Mr. Miller is Application Engineer, Centrifugal Pump Section, Allis-Chalmers Manufacturing Co., Milwaukee, Wisconsin. **His article points out an important limitation in pump capacity, and describes how to distinguish between net positive suction head and the limiting entering head.**

FOR THOSE who have experienced difficulty in expressing a pump's limitation in terms of *net positive suction head* (NPSH), perhaps the designation *limiting entering head* (LEH) may serve as a solution.

A pump can discharge only as much volume as it can receive. Limiting entering head is the measure for determining how much pumpable material can enter a pump, independent of its capability to produce discharge head or pressure.

The new designation of pump limitation, LEH, is original with Allis-Chalmers. The term is being used to minimize difficulties previously experienced in distinguishing between net positive suction head and the suction head itself. The suction head valve can be read on a gauge at the inlet of the pump, after the pump is primed but before it is operating. The limiting entering head valve cannot be read on a gauge (except in rare instances), but must be calculated.

Pump Capacity Considerations

The limiting entering head limits a pump's capacity or volume. The rpm and impeller diameter characteristics of a pump limit the head or pressure produced. In every pumping problem there are two LEH considerations: the required LEH of the pump and the available LEH of the installation site.

Pumping a liquid by displacement or by centrifugal force causes a lowered pressure at the pump inlet. New liquid will flow into this low pressure area if there is sufficient external force available to push it into the space as fast as it is being displaced. The measure of the external force required is termed the LEH of the pump.

Formula for LEH Value

A pump cannot move a liquid until the liquid enters the pump. LEH may be defined as the measure of the volume of liquid which can enter the pump. The formula may be given as:

Let Q = Volume of GPM
A = Inlet area of the pump
V = Velocity of the fluid
K = The pump designer's coefficient

Then $Q = AxVxK$

Since $V = \sqrt{2gh}$; therefore $Q = Ax\sqrt{2ghxK}$

K = A constant for a given pump

For a given size pump, the inlet area A is fixed and is a constant. 2g is also a constant, with g = pull of gravity (32.2).

Therefore, Q varies with "h"

"h" = LEH

"h" is the head of external force required to cause the desired volume, Q, to flow into the pump. Conversely, if "h" is fixed, it is the LEH, since it limits the quantity that can flow into the pump.

The formula is theoretical, and does not apply in actual practice due to design variations. Values must be determined from actual test. All pump curves have LEH (NPSH) designations plotted against volume in gpm. Therefore, it is unnecessary to calculate velocities or areas. It is necessary only to match the pump requirement with the available LEH. Somewhat more LEH value should be available than the minimum pump LEH requirement.

Effect of the Installation Site

Determine the elevation of the pump center line above or below the surface of the liquid entering head in feet.

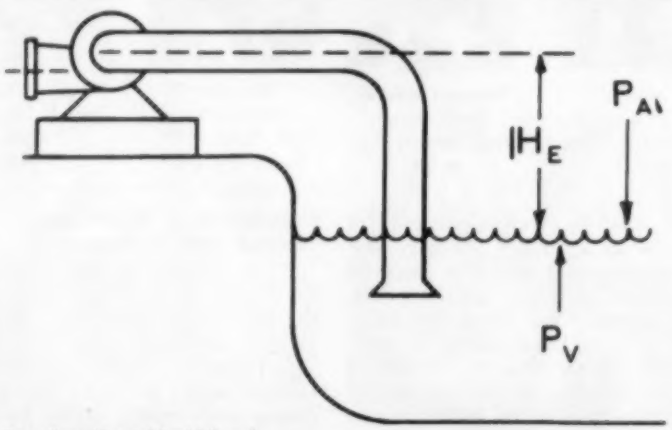
Determine the absolute pressure above the surface of the liquid PA converted to feet.

Determine the internal vapor pressure of the liquid due to temperature P_V converted to feet.

(PSI × 2.31) ÷ Sp. Gr. = feet

Then the available LEH = $(P_A - P_v) \pm H_E - H_F$

HF = Friction of suction piping, valves, screens, etc. in feet.



Pumping Above Liquid Level

Pumping water from a river, lake or reservoir at approximately sea level

$P_A = 34$ ft.

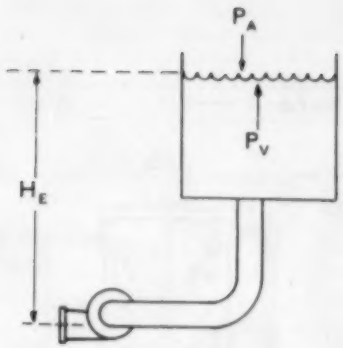
Water is 60°F $P_v = .6$ ft. $H_E = 10$ ft. Pipe friction 2 ft.

LEH = $(P_A - P_v) \pm H_E - H_F$

= $(34 - .6) - 10 - 2$

The available LEH = 21.4 ft.

For practical purposes the atmospheric pressure P_A will be reduced 1 ft for each 1000 ft elevation above sea level.



Pumping Below Liquid Level

Pumping water from a tank open to atmospheric pressure—elevation about 1000 ft above sea level.

$P_A = 33$ ft., water 160°F, $P_V = 11.2$ ft., $H_E = 12$ ft. Pipe friction $H_F = 2$ ft.

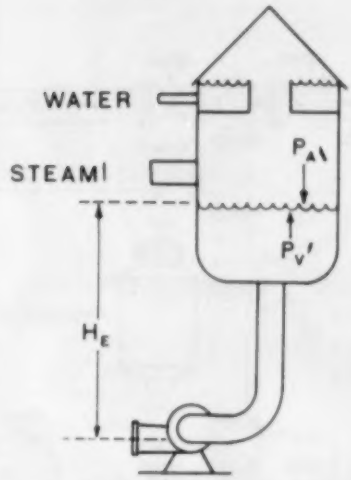
The available LEH = $(33 - 11.2) + 12 - 2 = 31.8$ ft.

If water temperature is increased to 212°F, $P_V = 33$, then the available LEH = 10 ft.

For other temperatures or liquids consult vapor charts.

Viscous fluids require corrections which can be obtained from charts.

Handling solids in suspension, paper stock, etc., requires special pumps and corresponding corrections from performance charts.



Pumping From Steam Pressure

Pumping water from a closed vessel or heater containing water subject to steam pressure. Water may be sprayed into the heater or cascaded in a series of waterfalls. The steam comes in intimate contact with the water and heats it to the same temperature as that of the incoming steam.

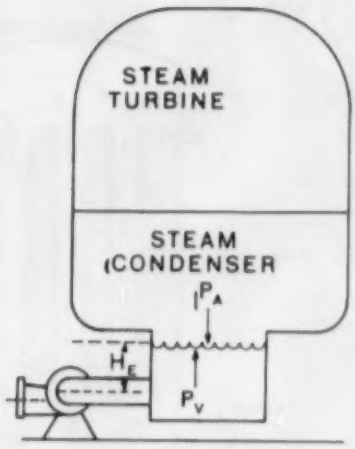
Steam 5 psig 227°F and $P_A = 19.7$ psia

Water in base of heater 227°F and $P_V = 19.7$ psia

$H_E = 37$ ft. $H_F = 2$ ft.

The available LEH = (19.7 psia − 19.7 psia) + 37 ft − 2 ft = 35 ft.

If the steam pressure is subject to sudden pressure drops, deduct the equivalent drop in feet from the available LEH before comparing with the minimum required LEH of the pump.



Pumping From Steam Condenser

A condensate pump removing water from a steam condenser. Because of construction and the expense of excavation, the hotwell is usually located just above the basement floor. H_E is very low, often only 2 or 3 ft and seldom over 5 ft. The condensate is at the saturation point, $P_V = P_A$ and H_F is negligible. The available LEH = $(P_A - P_V) + H_E - H_F$.

LEH = $0 + H_E - 0$; LEH = H_E

This H_E is often designated as "Sealing Head" or "Submergence."

Pumps with specially enlarged inlets are usually used for this service and extreme care must be taken in their selection because of the very low LEH. Cavitation and noisy operation are common occurrances because of lack of available LEH.

The above formula determines the difference in pressure between the state of the liquid and its boiling point, measured at the pump center line. It is known that when a liquid reaches the saturation point (boiling point) any further addition of heat or reduction in pressure will cause the liquid to vaporize.

It was stated earlier that a pump reduces pressure at the inlet due to the pumping action. The LEH value measures the limit to which the pump is permitted to reduce the pressure without vaporizing the liquid.

After determining the installation limitation, or available LEH, a pump can be selected to suit. Very often the installation LEH is very low, as with condensate pumps. Then, of necessity, a pump must be selected with a large inlet area, although it may operate at considerably less than the maximum efficient point of that pump.

If the inlet area of a pump is increased to satisfy a low LEH condition, some efficiency will be lost. This condition results in a greater horsepower requirement. There exists a definite optimum relationship between inlet area, width, and diameter of an impeller, to produce maximum pump efficiency.

It often is economical to change the installation LEH to permit use of a more efficient and perhaps a less expensive pump.

Be sure at all times that the installation LEH value is greater than the pump requirement, and that sufficient margin is allowed for sudden changes in the pressure on the surface of the liquid.

Practical Examples

Four practical examples of how the LEH value can be applied to actual installations are illustrated. In each instance, calculations are given for the pumping conditions specified.

George S. Lee Water Supt. At Cedar Rapids, Iowa

George S. Lee has accepted appointment to the position of Water Works Superintendent, Cedar Rapids, Iowa. Mr. Lee, a graduate of the State University of Iowa, came to Cedar Rapids as Chemist-Bacteriologist in June of 1954. Prior to this date he had been Production Manager at the Ottumwa Water Works.

H. F. Blomquist, who had retired in 1949 after 29 years as head of the water works, returned as acting superintendent until a permanent successor could be selected to replace Leo Louis who had left to accept the position of General Manager of the Gary-Hobart Water Corporation.

J. R. Van Duyne Retires From Passaic Valley Sewerage Comm.

J. Ralph Van Duyne, advisory engineer with the Passaic Valley Sewerage Commission for almost a year and its chief engineer for the preceding 34 years, has retired at the age of 76 to operate his farm in Warren County, N. J.

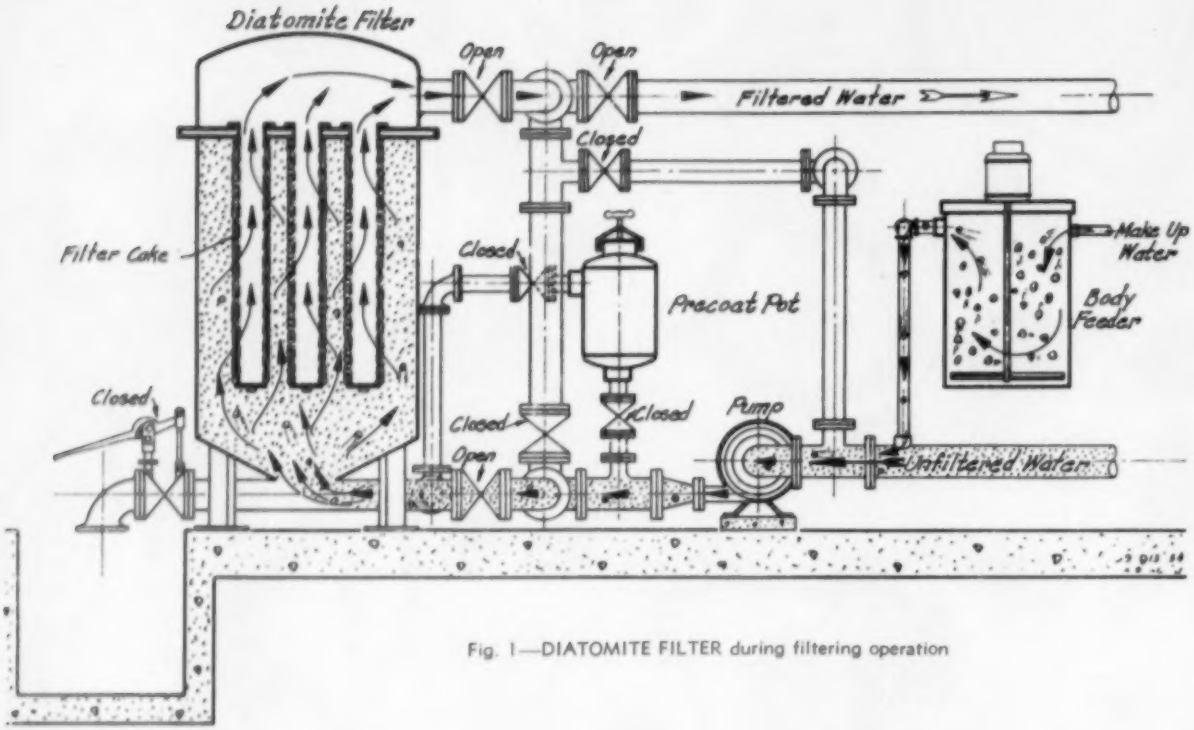


Fig. 1—DIATOMITE FILTER during filtering operation

Diatomite Filtration

As it is Known To-day

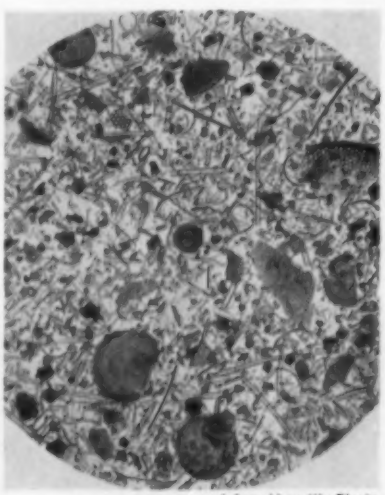
by CONRAD E. LAWLOR, Engr., General Filter Co., Ames, Iowa

IF YOU have been too busy the last few years to do much reading about this latest advancement in liquid filtration, this brief review may help you understand diatomite filtration as it is known today.

The diatomite filter (Fig. 1) is a straining unit, using diatomaceous earth as a filter membrane to remove materials in suspension in liquid.

What is diatomite? Geologists say it is the siliceous shells of tiny diatoms that once grew in great profusion on the earth. It has been said that there are some 10,000 different shapes (see Fig. 2). These diatoms form a very large deposit in California, where they lived some 5 to 20 million years ago. The chemists tell us these diatom skeletons are 89.7% silica. Fig. 2 is a micro-photograph of Johns-Manville's "Celite," one of the diatomites.

To the engineer, this material has a physical appearance of white face powder or finely milled white flour. It is very light and has great bulk per unit weight. Less than a half pound, (210 grams), has a surface area equal to the area of a football field, (45,000 sq.ft.).



Johns-Manville Photo

Fig. 2—DIATOMITE ("Celite" 512) under microscope

Note skeletons of siliceous diatoms in variety

Diatomite filtration has been proven by industry through years of use, but it has been only in the last eight years that the diatomite filter could be produced in quantity for filtration of water at a low cost to compete with sand filtration. Credit goes to the Armed Forces for first designing and using these filters during World War II. They were made to furnish potable drinking water under all field conditions. Small size and high filterability has now made them standard equipment with the U. S. Army. Organisms such as amoebic cysts and blood flukes could not be removed by rapid sand filtration. The diatomite filter does this job, even at high flow rates.

Filter Element and Membrane

In using diatomaceous earth for filtering liquids, it is necessary to use a filter element (Fig. 4) upon which a membrane, or filter cake, of the diatomaceous earth can be built. The

particles of the filter aid must form a rigid skeleton or fine lattice structure on the filter element. This is capable of capturing the gelantinous or fine particles of the unfiltered liquid and yet leave passage-ways in the filter cake through which the liquid, freed of suspended matter, may pass at a rate and under such pressure differential as is economical. Fig. 3 illustrates these points, and it becomes obvious that proper design of the filter element is most important. It is correctly said that the element is the heart of the filter.

Hydraulically there are but two ways to filter liquid, namely by positive pressure; or, by negative pressure, i.e., suction. However, the vacuum type diatomite filter is handicapped by its short runs between backwashes.

The Filter

The pressure type diatomaceous earth filter consists of a number of cylindrical filter elements supended from a plate within a pressure vessel —(see Figs. 1 and 4). The elements must have the characteristics of being durable, corrosion resistant, and must readily and easily clean during backwash. At the start of the filtering run, these elements are given a thin coat of diatomaceous earth, (called "precoat"), simply by introducing a charge of the earth into the filter inlet and then recirculating the water for several minutes. This coat of diatomaceous earth is the filter media which accomplishes the filtering result. As in sand filters, the dirt accumulates on the filter media, likewise, the loss of head through the media increases. This serves as the operators guide as to when it is time to backwash the filter.

The cleaning, or backwashing, is accomplished by surging the liquid backward several times through the filter to the point of backwash discharge. A quick opening valve (see Fig. 1 left side) is used in this operation and only a minute or two is required to completely clean the filter.

Some types of elements, because they have a tendency to plug with the diatomite, require compressed air to be properly cleaned. Most manufacturers of wire wound elements now recommend an air bump to clean the element. Some elements made of a more flexible material such a woven cloth, (see Fig. 4) are more easily cleaned because of their ability to expand and contract with the flow of water. It is similar to the action of washing clothes in a washing machine.

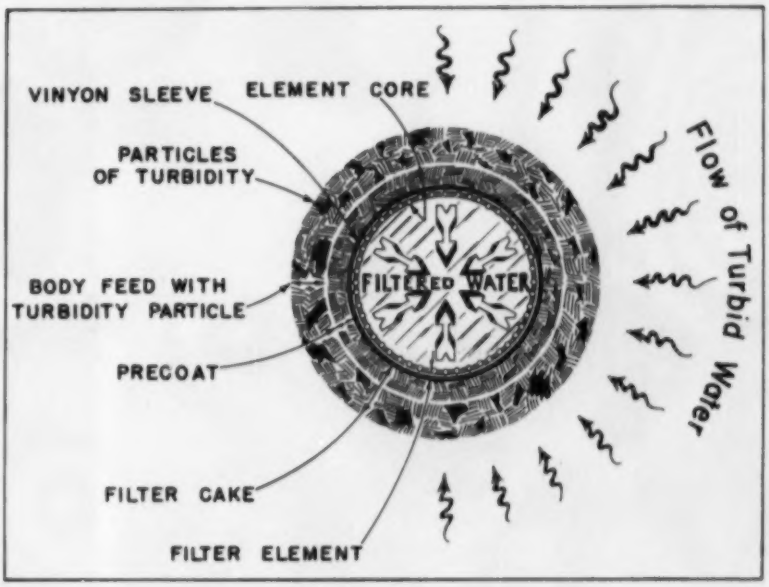


Fig. 3—FILTER ELEMENT in cross section

Shows relationship of core, vinyon sleeve, diatomite "precoat," and diatomite membrane, or filter cake. Body feed keeps filter cake porous.

Diatomaceous earth filters have been successfully used for a number of years in the sugar industry, and for clarifying ale, varnishes, beer, wines, soaps, dry cleaning fluids, and many other liquids. It is also employed to remove oil from condensate. The most recent employment of this equipment has been for filtration of swimming pool water. The sparkling clarity achieved with diatomaceous filtration, and also its compactness and lower cost, have made it increasingly popular.

Gen'l Filter Co. Photo

Fig. 4—FILTER ELEMENT of self-cleaning type

Woven element cloth is heavy duty DuPont acid resisting strainer cloth

Cost of this equipment usually runs a little lower than pressure filter installations of comparable capacity. Installation space is approximately one-third that required for pressure sand filters. Cost for chemicals, water and filter-aid is estimated to be comparable to the cost of operating sand filters.

Great care should be taken in selecting the filter for any given job. This is true because so far this method is in its infancy and, in fact, there are relatively few people who have had wide experience with diatomite filtration of liquids outside the laboratory. The new method is not a "cure-all" and diatomite filter plants should be carefully and conservatively engineered by experienced personnel in order to avoid prejudice against this method through misapplication.

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BIG RIG—An earth-boring machine cuts 4-ft. diameter hole, and DIGS DEEP—30 feet in 25 minutes.

Mechanization Makes Construction

by RAY DAY, Industrial Editor
La Canada, California

IN SOUTHERN California's San Fernando Valley, sewage contractors have successfully mechanized septic tank and leaching well construction. They did so not a minute too soon; without some faster method of installing these private sewage systems, the Valley might long ago have faced a serious crisis. The population of this area, covering 32 square miles, has jumped 700 per cent since 1930.

As a result of this new mechanization, the sewage contractors in the area have done some astonishing things. In 1948 the average price for a 750-gallon septic tank and a 20-foot leaching well was $450. Today, despite rising materials and labor costs, the average price for the same minimum system has dropped to $225. Probably in no other phase of the construction business has mechanization lowered costs so dramatically.

The old days of doing excavation work by hand labor and crab winches is about over. Contractors who persist in that method no longer can compete with firms whose equipment lets them do business at volumes of $40,000 to $90,000 a month. Big housing tracts, whose sewage system jobs run up to 500 units, are practically impossible to run on schedule without mechanization. Firms use improved earth-boring machines to finish up to 10 complete units a day. The soils under the San Fernando Valley floor are mostly granular and free-draining, so the area was a natural one for private leaching well and septic systems, and for a mechanization of methods of their construction.

The staggering growth of this area was aggravated further when light industry began to move in close to the enormous labor pool represented by that population. There is currently under consideration a major sewage disposal and outfall system, including a tunnel through the mountains leading to the Pacific Ocean, which will help to some extent to solve industry's problem. But the major bulk of the Valley system stacks up in favor of home sewage systems.

According to responsible officials of the State Board of Health, much good has been done by the leaching wells. In many areas, underground water supplies have been replenished so that salt water encroachment from the sea has been halted. The Valley's sewage contractors have even joined hands in the formation of the San Fernando Valley Sewage Contractor's Association. Meetings of the group are designed principally for their cooperative effect with State, County and City officials in working out mutual problems.

Mechanized Methods Developed

The mechanized methods which have been developed in the past few years are the last word in modern home sewage systems. Excavation is today much safer for company crews than it was 5 years ago, and considerably faster.

The Calweld earth-boring machine (capable of handling large-diameter buckets at depths up to 50 feet without a kelley bar extension) has proved especially well suited to practically every formation except solid rock. Equipped with special digging blades, the machine is used frequently in disintegrated granite in low hills bordering the Valley. For fast work in straight ground the machine is reported to be unbeatable.

A Calweld machine can be expected to dig a 30-foot leaching well and a 1,000-gallon septic tank, along with necessary excavation for the connections, in 1½ hours or less. Firms using the rig regularly dig more than 1 foot of 48-inch diameter leaching hole per minute with these machines.

The favorite excavation method consists of shallow bucket drilling

GOING UP—Leaching well is built above ground. GOING DOWN—Prefab wall is lowered in hole and steel frame is retracted.

# of Home Sewage Systems Economical

over the septic tank area, which roughs in that part of the work with a minimum of hand excavation. Several shallow holes are then drilled along the connecting ditch line, and the main excavation is made for the leaching well. Most contractors use 36-inch diameter earth-boring buckets, which do an adequate job on the septic tanks and connections. Six-inch reaming teeth then finish out the leaching wells as they go down.

One of the latest improvements in the Calweld machine is especially well suited to sewage excavation work, because it has eliminated all the hard physical labor in connection with heavy loads in the large-diameter buckets. It consists of a bucket-pulling device, operated from a winch on the machine through the necessary pipe outrigger and sheave arrangement. This improvement lets the operator pull his loaded bucket by power out over the spoil pile, where it can be dumped.

A Prefabricated Leaching Well

Over caving sand formations, which make for good drainage but dangerous digging, an especially safe and interesting method has been developed to build the dry well walls on top of the ground. The prefabricated unit is lowered into place as illustrated, without any workman ever being exposed to danger. The scheme has lowered costs wherever it has been used.

In this operation, the caving sand formation is excavated to oversize depth by a truck-mounted clamshell bucket. While the leaching well is being excavated, the block wall is stacked in place safely on top of the ground around a retractable steel frame, whose feet are so arranged that the form may be removed after the prefabbed well wall is lowered in. The lowering-in is done by the same crane which handles the clam bucket, after which the sand is backfilled.

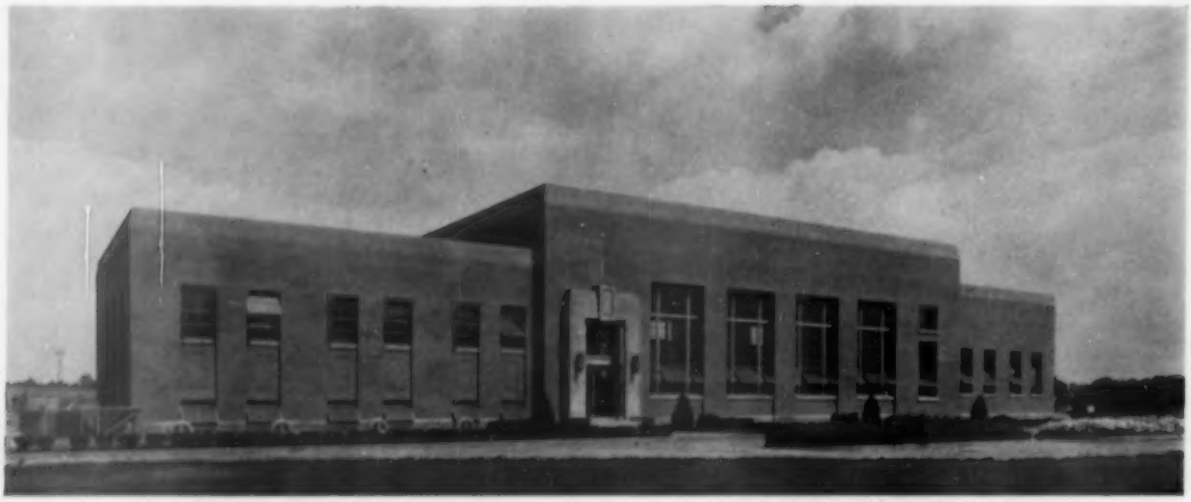
For bricking regulation leaching wells major outfits now use truck-driven dumb-waiter type hoists, which keep the bricklayer supplied. In fact, the bricklayer controls hoist and lowering action from down in the hole, with the aid of clutch-control ropes.

The days of laboriously pouring concrete to form septic tanks is over also. All the mechanized outfits now use standard prefabricated steel forms, which fit neatly into the excavations and which can be easily removed. Truck-mixed concrete is used. Other outfits have developed completely prefabricated septic tanks, which work excellently. Their only disadvantage is that they are ponderous and it takes a strong hoist to handle a large unit in soft terrain.

All Operations are Specialized

Practically all the leading outfits now schedule their operations around specialized crews. All excavation is assigned to the Calweld operators and helpers. Hand excavation and preparation for the installation of the tank, pool, and connecting lines is a job for still another crew. The crew which places and removes septic tank forms is mobile, mechanized and efficient. Even the final cleanup work is streamlined.

Instead of small-scale work and hip pocket office procedure, these modern outfits now work with the owners as coordinators in a central office. Jobs are scheduled with precision. It is good organization, mechanization and imagination such as this which has permitted San Fernando Valley to develop so rapidly without the usual crucial sewage problem. Costs continue to drop with each new advance in equipment, and productivity per man hour is increasing rapidly. The privately-built sewage systems, which will function for many years to come, help to reduce the demands made on already overloaded sewage treatment plants.



CANTON'S NEW $3,500,000 combination sewage treatment and garbage disposal plant

Gas Alarm System Protects Canton's New Treatment Plant

A Safety "Watchdog" that never sleeps

by J. J. WELCH, Pittsburgh, Pa.

POSITIVE and automatic detection of gas leaks at the new and modern $3,500,000 combination sewage and garbage treatment plant of Canton, Ohio, is assured by an instrument that continuously tests air samples in the plant's digester building for explosibility or combustibility.

Because the plant produces, handles and stores between 325,000 and 350,000 cubic feet of highly combustible digester gas daily, the scientific detection of leaks in piping, valves, meters, etc. is of first importance.

The digester building, housing a total of 6 primary and 4 secondary digestion tanks, is equipped throughout with spark-proof motors, explosion-proof lighting fixtures and similar protective accessories. But protection of personnel and property is strengthened by a combustible gas-analyzer and alarm system. Moreover, since operation of the plant depends entirely on the digester gas produced, the system provides a safeguard against interrupted service.

System Designed and Developed by M.S.A.

Designed and developed by Mine Safety Appliances Co. of Pittsburgh, Pa., the system at Canton is arranged to draw air samples from four strategically located points between the two rows of 90-foot diameter, 23-foot deep reinforced concrete digestion tanks. Combustible gas analyzers are not as well known in the sanitary field as in the industrial field, where this device has been widely used to warn of the hazard of explosive gases and vapors.

How the Analyzer Functions

Air is drawn from sampling locations to the analyzer through copper tubing by a turbo-compressor pump, powered by a ¼-horsepower explosion-proof motor, installed on the combustible gas alarm panel. Samples are passed over a detector filament which instantly determines the percentage of combustible or explosive gas in the sample.

Canton's analyzer is calibrated to sound an alarm when methane (CH_4) (principal combustible constituent of digester gas) in the sample reaches 40 per cent of its lower explosive limit. At that point, the instrument automatically energizes an alarm horn and by red indicator light on the panel reveals the exact location from which the gassy air sample was drawn.

An added advantage of the detector system is its concurrent control of exhaust fans in the digester building. Although the fans are equipped with switches for manual operation, when desired, they are set to go into action when the analyzer detects combustible gas concentrations approaching dangerous proportions. This conserves electricity because the fans only need operate when, and if, the atmosphere in the building becomes vitiated with the combustible gas. There is one exhaust fan for each sampling location. Fans are recessed in the concrete roof of the building and discharge to the outside through hoods with safety flashback arresters.

The plant management reports that the analyzer has operated on several occasions, detecting digester gas leaks, sounding an alarm and actuating the exhaust fans. As a check on dependability the instrument is periodically checked with a known concentration of methane gas. A built in air-flow meter, readable on the instrument panel, indicates to an operator that the air samples are passing through the unit properly.

The Gas Power System

The Canton plant, designed to handle an estimated future population of 160,000, presently serves approximately 130,000 urban and suburban residents. In 1953 it handled an average of 14.39 million gallons of sewage

DUAL DISPOSAL plant digests Canton's garbage and treats its sewage and digester liquor

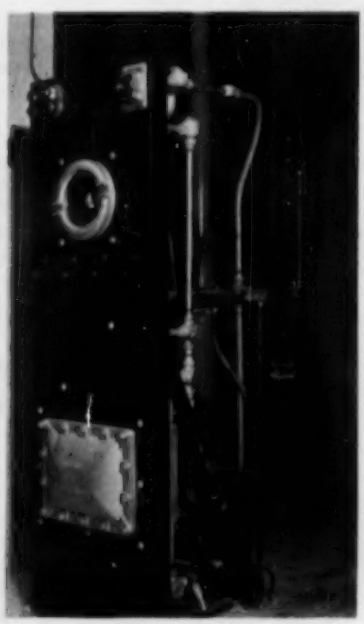
per day, plus garbage. Design of the plant is based on a flow of 30 million gallons of sewage per day and the digestion of Canton's garbage.

Gas produced in the digestion tanks, where sewage sludge and garbage is digested, has an average of 600 BTU content. It is used for heating buildings and for fueling the engines that drive the air blowers and pumps. The plant has three 390-horsepower, three 200-horsepower and two 90-horsepower gas engines. These engines are located in the main administration building. Because an uninterrupted supply of gas is essential to the plant's operation, the analyzer system assures continuity of plant service. Based on a commercial rate of 40 cents per thousand cubic feet, the estimated savings from use of digester gas for power is $120 per day.

Gas is collected from the domes of the six primary digestion tanks, which are heated to 95 degrees by pipe coils to speed up solids digestion and gasification. Excess gas is piped into the four secondary digesters which are equipped with floating steel covers and have a total gas capacity of 240,000 cubic feet. The innscuous digested sludge is pumped to a 600-acre farm and disposal area five miles south of the plant where it is used as a soil improver.

The Canton plant was designed by the engineering firm of Alvord, Burdick and Howson of Chicago. It was built by the Bass Construction Co. of Birmingham, Mich.

The Canton Sewage Treatment Plant is operated under the direct supervision of superintendent Gerald F. Johnson and assistant superintendent Geo. J. David. Canton's Service Director, under whose jurisdiction the plant is operated, is Henry Y. McCool.



MSA GAS ANALYZER and alarm system stands watch in ten unit digester gallery

Venturi Meter 42 Years Old Still in Good Condition

Report on results of inspecting Baltimore's 42-in. x 21-in. sewage Venturi

by C. E. KEEFER

Mr. Keefer is Deputy Sewerage Engineer, Dept. of Public Works, Baltimore, Md. His paper describes the inspection of a Venturi meter which has measured sewage flow for more than 42 years. Its present condition indicates many more years of useful life can be expected.

DURING November, 1911, two 42-in. x 21-in. Venturi-meter tubes and their indicating-recording registers (Fig. 1) were put in service at Baltimore, Md. These are located in the two 42-in. force mains discharging from the Eastern Avenue sewage pumping station.

This station, which is situated on the north side of Baltimore harbor, receives the sewage from about one-third of the city. The flow from the pumping station averaged 40.25 mgd during 1953 and has totaled 460 billion gallons from the date the station was put in service until May, 1954. This total quantity would fill a volume one mile square and 2,200 ft. deep. The amount of sewage that has passed through each of the two meters has been about the same.

Inspection After Long Service

As these Venturi meters have been in continuous service for over 42 years, it was considered desirable to inspect the interior of one of them. In order to do this, a force main was emptied and the manhole cover on the Venturi-meter tube (Fig. 2) was removed. Except for a thin film of material on the interior of the meter tube (Fig. 3), the walls were remarkably free of deposit. This film (Table 1) contained 66.15 per cent of moisture, 14.87 per cent of organic matter and 18.98 per cent of fixed solids.

The film also contained small pieces of scale, the analysis of which on the dry basis was as follows:

Organic matter	25.95%
Insoluble in HCl (SiO_2)	1.96%
Oxide of iron	71.95%
Undetermined	0.14%

The internal diameter of the bronze throat ring of the meter, before it left the factory in 1911, was 20.982-in. The diameters measured at the time of the inspection were as follows:

Location of measurement	Diameter in.
Vertical	20.990
	20.991
45° from vertical	20.987
90° from vertical	20.996
	20.998
135° from vertical	20.982

The maximum amount of wear in a vertical plane at the throat was 0.009 in. and in a horizontal plane 0.016 in. Even after 42 years of service the diameter of the throat was less than its nominal diameter of 21 in. It should be noted that the sewage is relatively free of grit, as the city is provided with a separate system of sewers.

Standard Concentric Tubes Recommended

The meter tube was of the conventional type, with the center line of the throat concentric with the center line of the up-stream piezometer ring. Some engineers have felt that this type of design may result in the formation of deposits along the invert adjacent to the throat in those installations where sewage is metered. They have consequently advocated that Venturi-meter tubes designed to measure sewage should have flat inverts.

An examination was made to see if there were any deposits in the invert of the meter inspected, but none were found. This inspection indicated that providing Venturi-meter tubes with flat inverts, which are twice as expensive as standard concentric

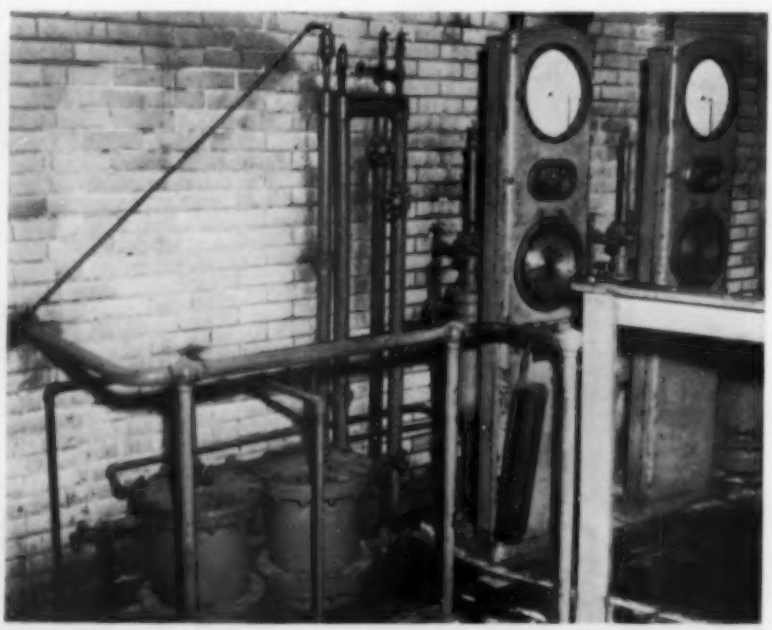


Fig. 1—THE INSTALLATION of indicating and recording registers with connecting piping for two 42-in. x 21-in. Venturi meter tubes.

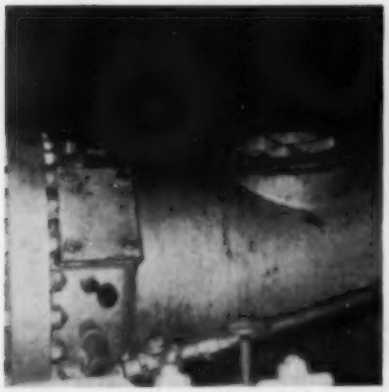


Fig. 2—Manhole and piezometer ring.

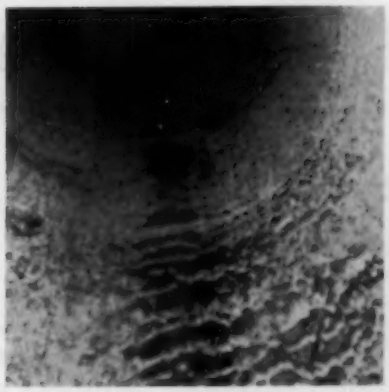


Fig. 3—Venturi interior showing deposit.

Fig. 4—Sewage solids in piezometer ring.

tubes, generally is not warranted where sewage is measured by these meters.

The cover plates on the handholes on the inlet and the throat pressure rings were removed (Fig. 4). A considerable deposit of material, consisting of grease, organic matter and sand (Table 1) was found to be located immediately beneath the plates. The piezometer rings themselves, however, were relatively free of deposits.

It was also found that some push-pull vent cleaners in the piezometer rings were worn. It is planned to replace the worn vent cleaners with stainless steel.

TABLE 1

Analyses of Deposits Removed from Inside of Venturi Tube and Piezometer Ring

	Interior of Tube	Interior of piezometer ring
Loss on evaporation	66.15%	34.89%
Organic matter	14.87%	30.64%
Grease	—	33.96%
Residue after ignition	18.98%	0.51%

Summary

Although these meters have been in service for over forty years, their condition indicates that they should have a useful life for many years to come.

The Eastern Avenue sewage pumping station is under the general direction of Paul L. Holland, director, Department of Public Works, and John J. Hunt, sewerage engineer. Abel Wolman is consultant to the Department of Public Works.

Itemized Water Bills Suggested —Not Easy, But Impressive

We quote below an impractical, but nevertheless impressive, suggestion from *Metrograms*, the Sparling Meter Company publication, February 1955 issue.

"The water bill, whether on flat rate or metered charge, is seldom received with a smile. Water is free to all, yet every month or so along comes a bill with unexplained charges. Why can't the water department itemize the bills?

"That would be hard to do, for most items carry no price tag. But if you want to take a shot at it, these items might be a guide to you:

Taking Care of the Watershed.....$.....
Maintenance and Operation of the Pumps or Intakes.....$.....
Amortization and Maintenance of Lines to the Plant.....$.....
Filtering, Softening and Purifying of all water distributed.....$.....
Storage to meet all emergencies.....$.....
Amortization and Maintenance of the Distributing lines.....$.....
Meter Maintenance and Reading.....$.....
Billing and Collecting.....$.....
Repayment of Capital Outlay.....$.....
Surplus for further Extension.....$.....

"For all these services, the customer pays 5(?) cents a ton, the lowest price for any commodity he buys. And the most essential he buys.

Charles B. Burdick Dies

Alvord, Burdick & Howson Partner Had Nation-Wide Experience

Charles B. Burdick, partner in the firm of Alvord, Burdick & Howson, consulting engineers of Chicago, long an Honorary Member of AWWA, died on February 17, after a very brief illness. He had been in excellent health until a week before his death.

Mr. Burdick, who was born in Chicago, on March 6, 1874, also centered his entire professional career there, following his graduation from the University of Illinois in 1895, but his practice was nationwide. To hydraulic and sanitary engineering, his contributions have been considerable. The original Niagara Falls filtration plant, which was built on his design some 43 years ago, was one of the first to demonstrate the effectiveness of filtration in reducing the incidence of typhoid, by successfully treating water contaminated by the sewage of Buffalo, about 20 miles upstream. His office designed more than 100 filtration plants, including some of the largest in the world.

Mr. Burdick's development of the fundamental principles involved in the collection of underground water, as illustrated by the country's largest infiltration gallery installation at Des Moines, Iowa, has been a marked contribution. His studies of floods, their occurrence and their control, made him an outstanding authority on this subject as well.

A member of AWWA since 1907, and an Honorary Member since 1944, Mr. Burdick was also an Honorary Member of the American Society of Civil Engineers, the Western Society of Engineers, and the Chicago Engineers Club.

New Fluosilic Acid Specifications In AWWA Standards

Water treatment plants interested in fluoridating their water supplies will be interested in the new specifications for fluosilicic acid prepared and published by the American Water Works Association, 521 Fifth Avenue, New York 17, New York. The 5-page booklet, AWWA B703, may be obtained with remittance of 20c.

REPORT FROM ABROAD

Sludge Treatment and Disposal Reviewed in British Report

by JOHN FINCH

Mr. Finch is Manager of the Sewage Disposal Dept., Rotherham, England. In his Report from Abroad, he discusses topics and opinions of timely interest. He will welcome the opportunity of replying personally to readers of *Water & Sewage Works* who require additional information regarding subjects covered in his series.

THE FIRST of a series of booklets, planned to discuss various departments and activities of the sewage treatment plant, has been recently published by the British Ministry of Housing & Local Government. It is in the form of a report by an informal working party on "The Treatment and Disposal of Sewage Sludge."

This may be considered one of the most authoritative and comprehensive documents connected with sludge treatment practices to be published in our field. The chairman of the party, Col. F. G. Hill, of the Ministry of Housing & Local Government, and the members of his working party, are to be warmly congratulated on the results of their efforts in producing a document which will be consulted as a standard reference on many occasions in connection with sludge treatment and disposal problems.

The personnel of the party is of significance, for it includes engineers and chemists interested in every branch of sludge treatment practice; their contributions cover both old well-tried methods and also modern methods not so well-tried and, in some instances, not so well accepted. The party has considered the advice of other workers in the field, and has drawn freely from the experiences of authorities in the U. S. and elsewhere. Discussion of the sludge problem is almost, but perhaps not entirely complete. Nevertheless, the report represents the last word on this all-important problem and is quite obviously a well reasoned and impartial resumé of the situation as it exists today.

Many Sludges—Many Treatments

Many different types of sludge are referred to, including amongst others: difficult domestic and trade waste mixtures, such as are produced at the Sheffield sewage plant, which are treated by lagooning; normal primary and secondary sludge mixtures treated by heated sludge digestion, lagooning and drying beds, as encountered at the Mogden plant; and primary sludge treated by heated sludge digestion and the separate treatment of secondary sludge by vacuum filtration, as carried out at the Colne Valley Sewerage scheme. Other methods of treatment, both practical and still in the experimental stage, are reviewed. These include heat treatment, centrifuging, flash drying, vacuum spray drying, freezing, drying by electro-osmosis, etc. Composting with house refuse also finds a place in the report. A representative of the Ministry of Agriculture and Fisheries is a member of the working party to cover the agricultural uses of sludge.

The party held its first meeting in January of 1952. It was given wide discretionary powers and terms of reference to study all the sewage sludge treatment and disposal methods as practiced in Great Britain, including costs of production and sales of by-products; to study similar data from overseas practice, and to study methods of sludge treatment and disposal in association with other materials in admixture or by composting.

Treatment and Disposal Costs

An important section of the report deals with costs of sludge treatment and disposal. Obviously, these costs vary considerably as a result of influencing factors such as type of process, extent of processing, by-products produced, and local conditions. Costs, exclusive of income, are reported on the basis of a survey of 72 principal sewage treatment plants in Great Britain; these provide important information in respect to the various processes of sludge treatment, perhaps for the first time in a single document.

These costs indicate that raw mixed-sludge treated by lagooning costs 15 shillings per dry ton; raw mixed-sludge air-dried on drying beds to around 65 per cent moisture content (the most common form of sludge treatment in Great Britain) costs 48 shillings per dry ton; digested mixed sludge air-dried on drying beds to 65 per cent moisture content costs 42 shillings (which cost does not take cognizance of the fact that at least 30 per cent of the gross tonnage treated is lost by digestion); digested primary sludge, elutriated, filtered, heat-dried to 35 per cent moisture content, and powdered (for sale in bulk) costs 155 shillings per dry ton. It is interesting to note that raw primary sludge shipped to sea costs 40 shillings per dry ton, based on prewar costs of sludge boats. Present day costs would be more than 100 per cent greater!

Sludge Disposal by Lagooning

The treatment and disposal of sludge by lagooning is undertaken by a number of sewage treatment authorities in Great Britain, the largest authority perhaps being the City of Sheffield, which has to deal with a very difficult sludge originating from domestic and trade wastes. This type of treatment and disposal has been in operation at Sheffield for a number of years, and has certainly served that authority very well. It may be of some value to examine it as a method of treatment which may be carried out economically where adequate areas of land are available.

The report states that the process of lagooning may be split up into three categories:

1. Digesting, thickening, and storage lagoons which are used as an intermediate stage between digestion plant and drying beds, or as a complete digestion stage.
2. Drying lagoons from which the sludge is removed periodically, and the lagoon is re-used.
3. Permanent lagoons in which the sludge remains stored indefinitely.

Design and Operation

The first category of lagoons should be rectangular in plan and of a suitable depth (about 12-feet); they should be equipped with feed and discharge pipes, decanting chambers, and means of returning the supernatant water back to the sewage flow. The report states that such lagoons should be constructed in units of three. These lagoons are fed with raw or partly digested sludge, and their contents may be discharged to drying beds during the summer months.

Lagoons in the second category are constructed very similarly to the first, but are not as deep (about 6-ft.). They may be operated as single drying lagoons. Where two lagoons are operated in series, the first (retaining the heavier solids) can be used as a drying lagoon, while the second (receiving the lighter solids) may be used as a digester, and its contents passed in due course to normal drying beds for dewatering. The operation may be speeded up by dredging with a drag-line after the lagoon has been standing full for about three months. This allows the water to leave the sludge and gravitate to the decanting chambers. On this basis, the period occupied in filling and drying is stated to be about two years; the moisture content of the sludge removed is about 70 per cent.

The Economy of Lagoons

Lagoons in the final category provide the cheapest method of disposal, and have been adopted by many authorities for some if not all of their sludge disposal. These permanent lagoons are really used for storage, the sludge being pumped directly to them; many are located on low land or in depressions in the terrain. Such lagoons should preferably be constructed in units of three; the routine being filling, digesting, and decanting supernatant water. Drying of sludge under these conditions may take several years.

That these methods of sludge treatment and disposal are of value is now well accepted, for they have passed the test of time. They have the advantage of being economical to construct and operate. The amount of

SLUDGE LAGOON—Details of sludge draw-off and decanting chamber

CATWALK to sludge chamber. Note earth banks of lagoon

SEWAGE CLARIFIER—Rectangular tank using travelling bridge scraper

work done in such lagoons is a never-failing source of amazement. They have been the means of alleviating overworked digestors on more occasions than one. A lagoon or a series of lagoons may be used to digest the sludge, dewater the sludge, condition the sludge, and contain it until such times as the sludge may be run onto drying beds. In fact, lagoons may serve as a maid-of-all-work, efficiently and without nuisance. I personally have much cause to be grateful for being fortunate enough to have had lagoons available at my plant for a good number of years; there are many men in Great Britain who would support that statement.

In the main conclusions and recommendations of this report, it is stated at the outset that accurate and systematic records should be kept at all treatment works. Such records provide a sound basis for subsequent alterations or extension to the plant—a fact with which every sewage works designer will heartily agree.

Selection of Disposal Method

A preliminary investigation should determine the best local means for final disposal of sludge, since prior treatment of the sludge will be dependent upon ultimate disposal. Subject to local conditions, the order in which disposal methods generally should be given consideration are:

1. Disposal of sludge in a liquid state, preferably after digestion, to manure grass lands and to produce multiple grass crops which (after heat drying) yield a high protein content animal fodder.

2. Disposal of sludge in a liquid state to manure land for general agricultural purposes, by controlled applications. (It is realized that sludge storage would be necessary during the closed season. This could be cheaply achieved by lagooning.)

3. Disposal of an end product having 40 to 50 per cent moisture content, for agricultural purposes.

4. Production of a drier product (10 per cent moisture or less) where there is a demand, and where the income will justify such procedure.

5. The disposal of sludge by composting with other waste materials such as house refuse, where conditions are favorable for assembling the ingredients at a reasonable cost.

The report emphasizes that digestion and drying lagoons have certain advantages over the more expensive shallow sludge beds, especially during the winter months; lagoons will produce at reasonable cost, an inodorous sludge of 60 to 70 per cent moisture content. The report also recommends the lagoon digestion process for all types of sludge and at all sizes of sewage treatment plants; excepting, of course, where the sludge is toxic, or where there is any other valid reason.

It is recognized that the processes of consolidation and elutriation make for economy in sludge treatment and dewatering, especially in the larger plants. Evidence points towards rotary kiln and band-dryers as having advantages for special applications in the recovery of the by-products while, for general purposes, the flash dryer appears to offer the most promising results.

Preliminary Handling of Sludge

In a short review of methods for settling sewage solids, the report states that aids to sedimentation, such as pre-flocculation have proved their worth; it now is clearly established that practically all types of sludge should be removed from settling tanks in as fresh a state as possible. The report favors the travelling bridge type of mechanism for rectangular settling tanks and the rotating mechanism for circular tanks. The report indicates that the flight scraper type of desludging mechanism is unlikely to prove popular in Great Britain owing to the high cost of the required tank construction and of the mechanism itself.

The travelling bridge type of scraper has so far been confined in use to the removal of primary tank sludges, or of mixed primary and secondary tank sludges. The flight scraper mechanism has been used for all classes of sludge. The travelling bridge scraper has been manufactured in light aluminum alloys, sufficiently strong to span a rectangular settling tank 114 feet in width at the Nottingham sewage treatment plant. It appears that the use of these light alloys will most probably extend the application of the bridge type scraper to the larger sized settling tank, where previously a steel structure would have been unduly heavy and cumbersome. There are, of course, many applications of travelling bridges on rectangular settling tanks in Great Britain; although the tendency in new design is to adopt circular tanks, it still is likely that new rectangular tanks will be installed. The conversion of many of the older manually desludged tank installation to mechanical scraping will obviously continue.

According to opinion expressed in the report, a well-designed primary settling tank should aim at the removal of at least 90 per cent of the settable solids, with a simultaneous reduction in the BOD of about 45 per cent. Regarding two-stage settlement, the report indicates that, where both tanks are mechanically cleaned, no advantage is normally gained; single-stage settlement with capacity equal to that of two stages having been shown to produce equal efficiencies.

A report of this nature, prepared by an informal working party, constitutes a new departure in the sewage treatment field in Great Britain, and one that is most useful. The experts have tackled an important aspect of sewage treatment practice, and have produced a 64-page document of concise data covering a wealth of practice in the field. All sewage treatment plant operators and designers will find the report highly engrossing in character, and some will find it somewhat provocative in nature, but all-in-all it is a "must" for the bookcase of every sewage treatment authority and engineer's office, as a work of reference. Col. Hill of the Ministry of Housing & Local Government, who took a prominent part in the compilation of the very excellent O.E.E.C. report on U. S. practice, has now in his own department produced an equally important report which may be the forerunner of others.

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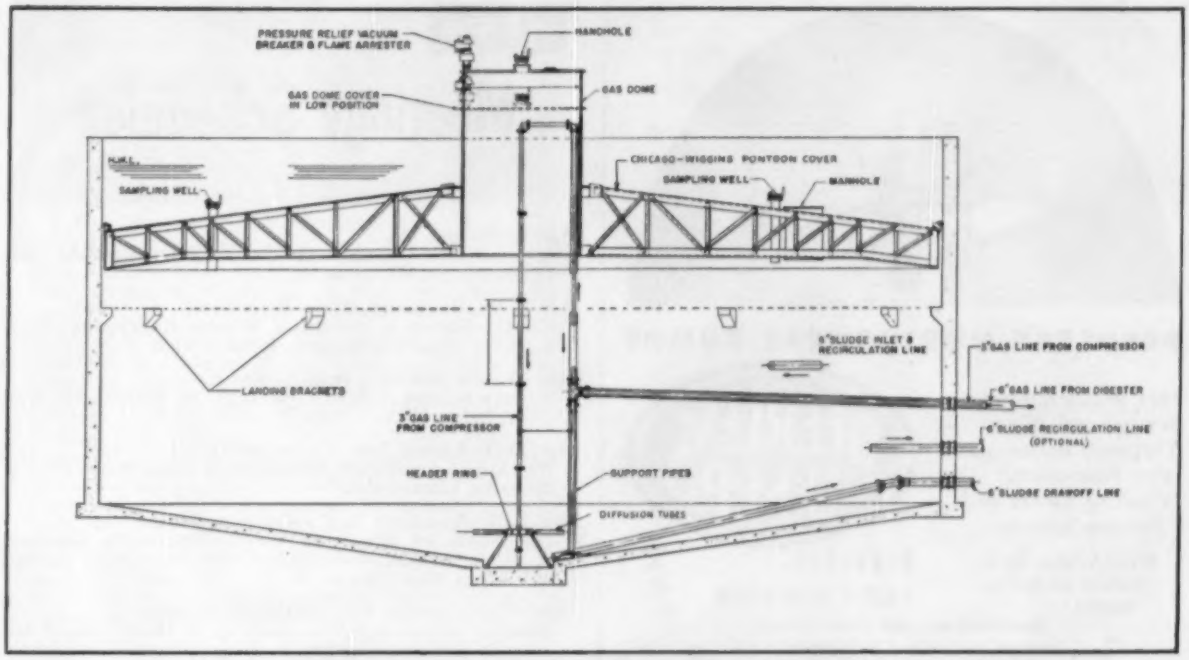

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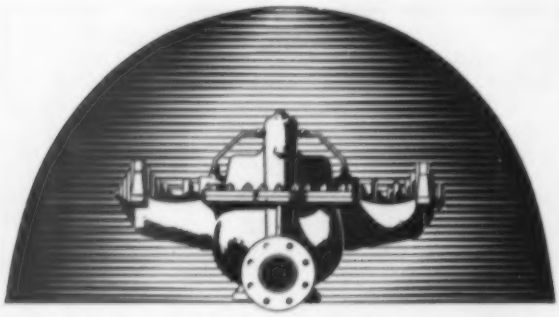

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W & SW

Meetings Scheduled

Apr. 13—Bangor, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Apr. 13-15—Hutchinson, Kans. *(Baker Hotel)*
KANSAS SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Robert H. Hess, City Building, Wichita, Kans.

Apr. 13-15—Hutchinson, Kans. *(Baker Hotel)*
KANSAS SECTION A.W.W.A. Sec'y, H. W. Bradley, 119 West Cloud, Salina, Kans.

Apr. 13-15—Lincoln, Neb. *(Cornhusker Hotel)*
NEBRASKA SECTION A.W.W.A. Sec'y, E. Bruce Meier, Univ. of Nebraska, Lincoln, Neb.

Apr. 13-15—New York, N. Y. *(Manhattan College)*
CONFERENCE ON BIOLOGICAL WASTE TREATMENT. Chairman, W. W. Eckenfelder, Ass't. Prof. of Civil Engineering, Manhattan College, New York 71, N. Y.

Apr. 14-16—Chandler, Ariz. *(San Marcos Hotel)*
ARIZONA SECTION A.W.W.A. Sec'y, Q. M. Mees, Univ. of Arizona, 721 N. Olsen Ave., Tucson, Ariz.

Apr. 14-16—Chandler, Ariz. *(San Marcos Hotel)*
ARIZONA SEWAGE & WATER WORKS ASSOCIATION. Sec'y, Quentin M. Mees, 721 N. Olsen, Tucson, Ariz.

Apr. 18-20—Quebec, Can. *(Chateau Frontinac)*
CANADIAN SECTION A.W.W.A. Sec'y, Dr. A. E. Berry, Dept. of Health, Parliament Buildings, Toronto, Ont., Can.

Apr. 20-22—Buffalo, N. Y. *(Statler Hotel)*
NEW YORK SECTION A.W.W.A. Sec'y, Kimball Blanchard, 56 Grand Street, White Plains, N. Y.

Apr. 21—Hartford, Conn. *(New Hotel Staler)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y Jos. C. KNOX, 204 Tremont Bldg., Boston, Mass.

Apr. 27-30—Riverside, Calif. *(Mission Inn)*
CALIFORNIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, J. C. Mallery, 4822 Dunsmore Ave., LaCrescenta, Calif.

Apr. 28—Butte, Mont. *(Finlen Hotel)*
MONTANA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Harry W. Taylor, Morrison & Maierle Inc., Helena, Mont.

Apr. 29-30—Butte, Mont. *(Finlen Hotel)*
MONTANA SECTION A.W.W.A. Sec'y, A. W. Clarkson, State Dept. of Health, Helena, Mont.

May 4-6—Pittsburgh, Pa. *(Hotel Webster Hall)*
PENNSYLVANIA SECTION A.W.W.A. Sec'y, L. S. Morgan, State Dept. of Health, Greensburg, Pa.

May 9-11—Lafayette, Ind. *(Purdue University)*
TENTH PURDUE INDUSTRIAL WASTE CONFERENCE. Director, Professor Don E. Bloodgood, Purdue University, W. Lafayette, Ind.

May 10—Newark, N. J. *(Hotel Essex)*
NEW JERSEY SECTION AMER. INST. OF CHEMICAL ENGRS. (Symposium featuring control of stream pollution). John N. Whelan, E. I. DuPont de Nemours & Co., Parlin, N. J.

May 19—Springfield, Mass. *(Hotel Kimball)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y Jos. C. KNOX, 204 Tremont Bldg., Boston, Mass.

May 19-21—Yakima, Wash. *(Chinook Hotel)*
PACIFIC NORTHWEST SECTION A.W.W.A. Sec'y, F. D. Jones, Room 305, City Hall, Spokane, Wash.

May 25—Trenton, N. J. *(Tentative)*
NEW JERSEY SECTION A.W.W.A. (Summer Outing). Sec'y, C. B. Tygert, Box 178, Newark, N. J.

June 8—Bar Harbor, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

June 12-17—Chicago, Ill.
AMERICAN WATER WORKS ASSOCIATION. (75th Annual Convention). Exec.-Sec'y, Harry E. Jordan, 521 Fifth Avenue, New York 17, N. Y. (All reservations being cleared through A.W.W.A. office.)

June 13-14—Albany, N. Y. *(Hotel Ten Eyck)*
NEW YORK SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, R. C. Sweeney, 21 No. Broadway, White Plains, N. Y.
(joint meeting with)

June 13-14—Albany, N. Y. *(Hotel Ten Eyck)*
NEW ENGLAND SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Stephen M. Hurley, Jr., 331 State Office Bldg., Providence, R. I.

June 16—York Harbor, Maine, *(Marshall House)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

June 22-24—Rochester, Minn. *(Kohler Hotel)*
CENTRAL STATES SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Geo. F. Bernauer, 713 Chapman St., Madison, Wis.

June 22-24—Columbus, O. *(Deshler-Hilton Hotel)*
OHIO SEWAGE & INDUSTRIAL WASTES TREATMENT CONFERENCE. Sec'y, Ward E. Conrad, 301 Ohio Departments Building, Columbus, O.

Aug. 15—Richmond, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Aug. 22-24—State College, Pa. *(College Dormitories)*
PENNSYLVANIA WATER WORKS OPERATORS ASSOCIATION. Sec'y, R. Rupert Kountz, Penn. State University, State College, Pa.
(joint meeting with)

Aug. 22-24—State College, Pa. *(College Dormitories)*
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, B. B. Bush, State Dept. of Health, Kirby Health Center, Wilkes Barre, Pa.

Sept. 7-9—Saranac, N. Y. *(Saranac Inn)*
NEW YORK SECTION A.W.W.A. Sec'y, Kimball Blanchard, 56 Grand St., White Plains, N. Y.

Sept. 7-9—Fort Dodge, Ia. *(Hotel Waukonsa)*
IOWA SEWAGE WORKS ASSOCIATION. Sec'y, L. F. Skorczeski, 207 South 15th Ave., Marshalltown, Ia.

Sept. 12-14—Lexington, Ky. *(Phoenix Hotel)*
KENTUCKY-TENNESSEE INDUSTRIAL WASTES & SEWAGE WORKS ASSOCIATION. Sec'y, S. Leary Jones, 420 Sixth Ave., Nashville, Tenn.

Sept. 12-14—Lexington, Ky. *(Phoenix Hotel)*
KENTUCKY-TENNESSEE SECTION A.W.W.A. Sec'y, J. Wiley Finney, Jr., 553 S. Limestone St., Lexington, Ky.

Sept. 14-16—Flint, Mich. *(Durant Hotel)*
MICHIGAN SECTION A.W.W.A. Sec'y, T. L. Vander Velde, State Dept. of Health, Lansing, Mich.

Sept. 18-22—Lake Placid, N. Y. *(Lake Placid Club)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Sept. 19-21—Laramie, Wyo., *(Connor Hotel)*
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Sept. 21-23—Milwaukee, Wis. *(Hotel Schroeder)*
WISCONSIN SECTION A.W.W.A. Sec'y, Leon A. Smith, City Hall, Madison, Wis.

Sept. 25-27—Joplin, Mo., *(Connor Hotel)*
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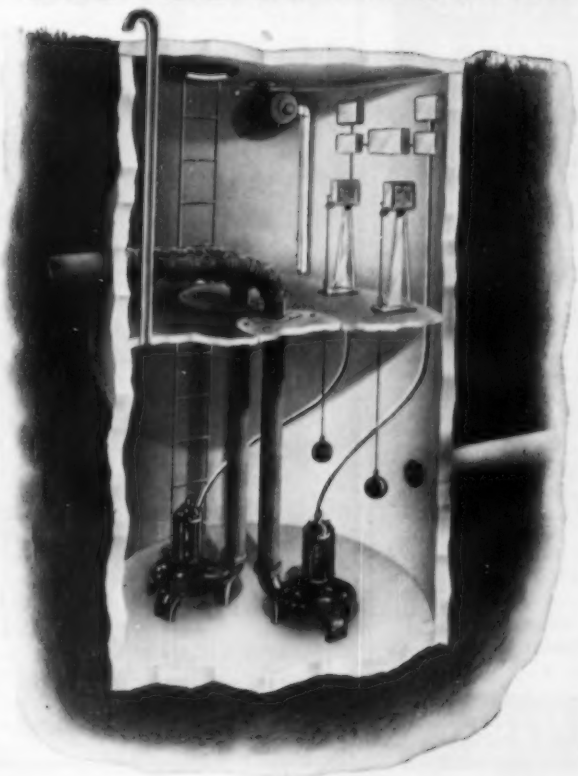

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Oct. 4-5—Springfield, Ill. *(Place not selected)*
ILLINOIS WATER PLANT OPERATORS CONFERENCE, ANNUAL MEETING. Clarence W. Klassen, Chief San. Engr., State Dept. Public Health, Springfield, Ill.,

Oct. 10-13—Atlantic City, N. J. *(Ambassador Hotel)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSOCIATION. (Annual Meeting). Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.
(joint meeting with)
Oct. 10-13—Atlantic City, N. J. *(Ambassador Hotel)*
NEW JERSEY SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, M. S. Kachorsky, P. O. Box 766, Manville, N. J.

Oct. 11-14—Atlantic City, N. J., *(Chalfont Hotel)*
PENNSYLVANIA WATER WORKS ASSOCIATION (Annual Meeting) Sec'y, Davis Dunlap, *2609* N. Second St., Harrisburg, Pa.

Oct. 12—Norridgewock, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Oct. 16-19—San Antonio, Tex. *(Gunter Hotel)*
SOUTHWEST SECTION A.W.W.A. Sec'y, Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 19-20—Clarksburg, W. Vir. *(Waldo Hotel)*
WEST VIRGINIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION (9th Annual Meeting) Sec'y, G. O. Fortney, State Dept. of Health, Charleston 5, W. Vir.

Oct. 19-21—Des Moines, Ia.
IOWA SECTION A.W.W.A. Sec'y, H. V. Pedersen, Municipal Bldg., Marshalltown, Ia.

Oct. 20-21—Clarksburg, W. Va. *(Waldo Hotel)*
WEST VIRGINIA SECTION A.W.W.A. Sec'y, Harry K. Gidley, State Dept. of Health, Charleston, W. Va.

Oct. 20-22—Atlantic City, N. J. *(Madison Hotel)*
NEW JERSEY SECTION A.W.W.A. (Fall Meeting). Sec'y, C. B. Tygert, Box 178, Newark, N. J.

Oct. 24-28—New York, N. Y. *(Hotel Statler)*
AMERICAN SOCIETY OF CIVIL ENGINEERS. (Annual Meeting). Sec'y, Wm. N. Carey, 33 West 39th St., New York, N. Y.

Oct. 25-28—Sacramento, Calif. *(Senator Hotel)*
CALIFORNIA SECTION A.W.W.A. Sec'y, Henry F. Jerauld, 1040 Manzanita, Pasadena, Calif.

Oct. 26-28—Washington, D. C. *(Hotel to be announced)*
CHESAPEAKE SECTION A.W.W.A. Sec'y, Carl J. Lauter, 6955—33rd St., Washington, D. C.

Oct. 30-Nov. 2—Biloxi, Miss. *(Buena Vista Hotel)*
ALABAMA-MISSISSIPPI SECTION A.W.W.A. Sec'y, Charles W. White, 537 Dexter Ave., Montgomery, Ala.

Nov. 3-5—Richmond, Va. *(Jefferson Hotel)*
VIRGINIA SECTION A.W.W.A. Sec'y, J. P. Kavanagh, 213 Carlton Terrace Bldg., Roanoke, Va.

Nov. 6-9—Orlando, Fla. *(Hotel to be announced)*
FLORIDA SECTION A.W.W.A. Sec'y, Harvey T. Skaggs, P.O. Box 2328, Jacksonville, Fla.

Nov. 6-9—Orlando, Fla., *(Orange Court Hotel)*
FLORIDA SEWAGE & INDUSTRIAL WASTES ASSOCIATION (Annual Meeting) Sec'y-Treasurer, M. E. Dawkins, P.O. Box 210, Jacksonville, Fla.

Nov. 14-16 *(Place not selected)*
NORTH CAROLINA SECTION A.W.W.A. Sec'y, Wilber E. Long, Jr., 1615 Bickett Blvd., Raleigh, N. C.

Nov. 14-18—Kansas City, Mo. *(Municipal Auditorium)*
AMERICAN PUBLIC HEALTH ASSOCIATION (83rd Annual Meeting). Exec.-Sec'y, Dr. Reginald M. Atwater, 1790 Broadway, New York, N. Y.

Dec. 14—Augusta, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

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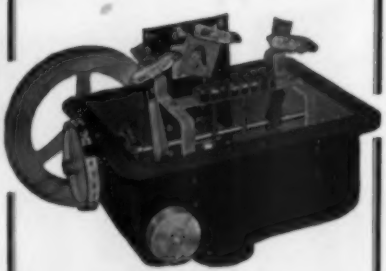
ROTO-TROL



RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles. The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

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W & SW

Spillway

OVERFLOW FROM THE MAIN SECTION

W. C. Tims Becomes Supt. Of Carol City, Fla., Utilities

William C. Tims has been appointed to the position of Superintendent of Carol City Utilities, Inc., Dade County, Florida. Tims was presented the L. H. Scott award last year by the Florida State Board of Health for the most advanced operating techniques in waste disposal.. He comes to Carol City from the city of Tampa, where he managed the installation and operation of the master sewer system.

Mr. Tims was chief sanitary engineer for the University of Miami when the school installed its first water and sewage plants in 1948. After World War II, he was appointed engineer for the city of Key West. During the war years he served in a civilian capacity with the State Board of Health, the national engineering firm of Stone and Webster, and at Camp Blanding.

When completed to serve 10,000 families, the Carol City utility system will cost $4.5 million. The first section now in operation will serve about 1500 homes. The final plant will be the largest private water and sewage treatment utility of its type in the South. The engineering firm of Clifford & Associates, Miami Springs, was designers of the plants.

Quarter Century Club Banquet Of Roberts Filter Co.

The Seventh Annual banquet of the Quarter Century Club of the Roberts Filter Manufacturing Company, Darby, Pa., was held in November, 1954, for employees who have served the Company for 25 or more years. One new member was admitted to the Club, making a total of 27 service and 3 honorary members. Bernard J. Brennan was elected President and Harold W. Pugh was reelected Secretary of the Club for the coming year.

Robert S. Millar Moves To New Post At Denver, Colo.

Robert S. Millar, long well known as manager of the Wichita Water Company, has resigned to accept the post of Assist-Manager for the Denver, Colorado, Board of Water Commissioners. Always active in A.W.W.A. affairs, Millar has served as Kansas Section Chairman. He is being succeeded in Wichita by J. W. Heiney, Assistant Division Manager of the Western Division, American Water Works Service Company.

Des Moines Water Board Adopts $4.5 Million Program

The Des Moines Water Works board of trustees voted in January to adopt "in entirety" a long-range plan presented by consulting engineers for a $4,594,000 expansion.

The board also authorized the engineering firm — Alvord, Burdick & Howson of Chicago, Ill.—to proceed at once with plans and specifications for the first step in the program.

Dale L. Maffitt, water works general manager, called approval of the long-range plan "the biggest decision the board has made in a long time."

It was generally agreed by board members that they would "make every effort" to pay for the expansion out of water works profits, without issuing bonds.

Paul Farrell Drowning Was Accidental

In our February issue we carried a brief report of the death, on January 8th, of R. P. Farrell, Director of the Dept. of Sanitary Engineering, Kentucky State Department of Health.

We have since received more complete information which reports that Paul Farrell drowned as a result of an accident while on a fishing trip.

Industrial Waste Disposal Charges Topic of New APWA Report

Special Report No. 18-S, titled "Industrial Waste Disposal Charges in Cities Over 5,000 Population" has been published by the Amer. Public Works Assn. as a companion publication to the Association's Special Report No. 18 which summarized sewage service charges. The latest report was prepared by a committee: John Baffa, Gordon Burt, Samuel M. Clarke, Edward J. Cleary, Leon A. Smith, and J. F. Laboon, Chairman.

The committee conducted a survey of those cities known to be making charges for sewage and industrial waste disposal service, and the Association's headquarters staff collected additional information. Industrial waste disposal charges were reported made by more than 256 cities and sanitary districts in this population classification.

Part I of the 81-page report is devoted to a summary of charges and the bases of computation; Part II describes the regulations in force and various related data.

For copies of this useful report address Donald F. Herrick, Executive Director, American Public Works Assn., 1313 East 60th Street, Chicago 37, Ill. The price is $3.00 per copy.

Henry Van Der Vliet Joins Bergen County Sewer Authority

Henry Van Der Vliet, superintendent of the Joint Meeting Rutherford, East Rutherford and Carlstadt sewage disposal system, has recently been named as a member of the Bergen County (N. J.) Sewer Authority.

A resident of Maywood since 1922, Mr. Van Der Vliet is a member of the Board of Examination and Licensing of the New Jersey Department of Health; a member of the executive committee and past president of the New Jersey Sewage and Industrial Wastes Association; member of the planning committee of the Federation of Sewage and Industrial Wastes Associations for the 1956 convention; and past president of the North Jersey Sewage Association.

Mr. Van Der Vliet is also superintendent of the Maywood sewage treatment plant and is a consulting superintendent for the City of Hackensack.

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

W&SW

New Equipment

Utilities Dipper Available For Hydrohoe

401

Bucyrus-Erie Co., South Milwaukee, Wis., has developed a new utilities dipper for use on the Hydrohoe. It is "tailor-made" for Hydrohoe users in the Public Utilities field, designed to meet their need for a shorter dipper which can be rotated within a smaller arc than the standard wrist-action dipper.

A very high percentage of jobs in this busy market are small and in confined areas. For such an operation as leak repair to water mains, for example, where all that is involved is uncovering a pipe joint so it can be clamped, the smaller the hole, the better. Time is saved, traffic is not interrupted and the cost of backfilling with gravel and repairing the street is minimized.

Excavating for a house connection, where the distance between street curb and sidewalk may be as short as three feet, also requires a shorter dipper.

The utilities dipper has an overall width of 22 inches. With side cutters, cutting width is increased to 26 inches. Approximately 2 feet shorter than the standard wrist-action dipper from handle connection to tooth points, this dipper can dig a hole 5 feet deep and only 36 inches long, with vertical walls and comparatively flat bottom.

Instead of rotating 65 degrees, or from 40 degrees behind the handle to 25 degrees ahead of the handle as with the standard wrist-action dipper, the utilities dipper rotates 95 degrees, or from 45 degrees behind to 50 degrees ahead. The pivot point for the automatic ejector is so arranged that the ejector door is near the tooth points for cleaner dumping.

Porto Pump Offers Choice of Two Motors

402

Porto Pump Incorporated, Detroit, Michigan, has announced that the Porto Pump with rubber gear construction is now available with a choice of two motors. In addition to the Wisconsin AKN engine, it can now be obtained with a Kohler K160 engine.

The Kohler powered pump is extremely portable—its weight is only 89½ lbs. The pump is mounted directly to the engine and power is transmitted through a self aligning flexible coupling which absorbs shock. The rubber gear construction permits use of most water sources, dirty or clean and can be used for pressure testing water mains and fire sprinkling systems, jetting operations, and various other uses requiring a portable pressure pump.

Portable Power Vise Stand for Hand Tools

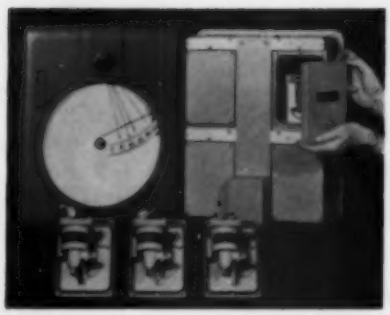
403

The Oster Manufacturing Company, Cleveland, Ohio, has developed a new portable power drive for hand pipe tools called the No. 432 "Lightweight Champ" Power Vise Stand.

Capacity of the "Lightweight Champ" is ⅛" to 2" pipe and up to 8" pipe when hooked up to a geared drive shaft.

In addition to driving die-stocks, pipe cutters and reamers, the No. 432 can be used to turn up or back-off fittings. Can also be furnished with attachment for bar twisting.

Features of this new unit include, new streamline construction, lighter weight, a more powerful motor, unbreakable steel welded case, two driving arms on center line with spindle and Wrenchless front chuck that insures positive "No-Slip" grip in both right and left hand direction.



Recorder Has Plug-in Receivers And One-year Automatic Inking

404

Bailey Meter Co., Cleveland, Ohio, has developed a new Recorder that is a receiver recorder for pneumatic and electric transmission systems in power and process plants. It will record any measured variable which may be converted to pneumatic or electric signals.

For the first time a standard recorder is available which keeps continuous, independent records of one to four pneumatic and electric transmissions in any combination. Unique, plug-in, precalibrated receivers make this advancement possible.

Receiver units may be added or interchanged, permitting easy field adaptation to new or revised metering and control applications. Two, plug-in escapement-type integrators may be included in the same casing with two flow records.

Fountain-type recording pens provide continuous feed for one year without refilling. The new pens are stainless steel capillary, fed from hermetically-sealed ink sacs.

The new recorder is designed for panel mounting, requiring a cutout only 14" x 17". Panel bolt holes and studs are not required. Recorders are available in green, buff, grey, or black baked enamel finish.

Table-Type Blast Cleaner

405

American Wheelabrator & Equipment Corp., Mishawaka, Indiana, has developed a new table-type airless blasting machine. The machine, called

a 72" Wheelabrator Swing Table, is distinct from other swing-table-type airless blasting machines in that it requires no pit at all for the abrasive hopper, whereas other types in the past have required them.

Special features of this machine are the 72" diameter plain work table which is mounted on the door of the machine. When the door is open, the work table comes out of the machine for ease in loading and unloading. When the door is shut, the table automatically moves into the blasting zone of the machine and rotates the work under the abrasive blasts from a rotating, bladed wheel mounted in the cabinet roof.

Truck Crane Speeds Up Loading and Unloading

406

Truck-Crane, Inc., Chicago, Ill., has introduced a new, self-contained materials handling crane for trucks. It is said to convert any standard truck into a dual-purpose hauling and handling unit. The unit itself, called a Truck-Crane, will lift up to 5,000 pounds at one time, swing it onto the truck, lift it off, and spot it anywhere desired within a 16 ft 280° radius of the truck. It allows loading and unloading anywhere a truck can be driven.

The complete unit takes up only 18 inches of space behind the truck cab. The boom swings in a 280° arc—unloads on either side, front or rear of the truck. The traveling carriage on the boom spots the loads. When unloading, hydraulically controlled outriggers stabilize the truck. The complete mechanism is hydraulic, with controls for boom, winch, carriage, and outriggers operable from control panels on both sides of the truck. One hand lever reverses, locks, or operates the winch at the speed desired. A safety feature is the power cut-off—all power movements lock automatically when levers are released. Depending on the job, one or two men can handle any type of load.

No. 1* of . . .

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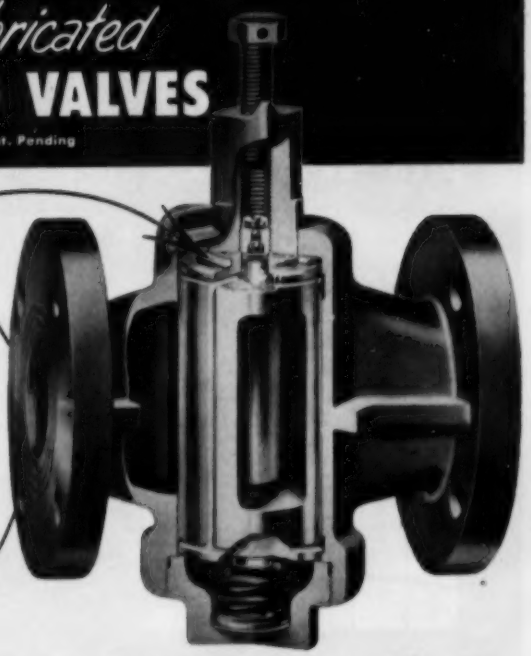

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. . . which will not cold-flow, and which provides a positive seal against leakage—even under 200 pounds pressure per square inch, *without lubrication*.

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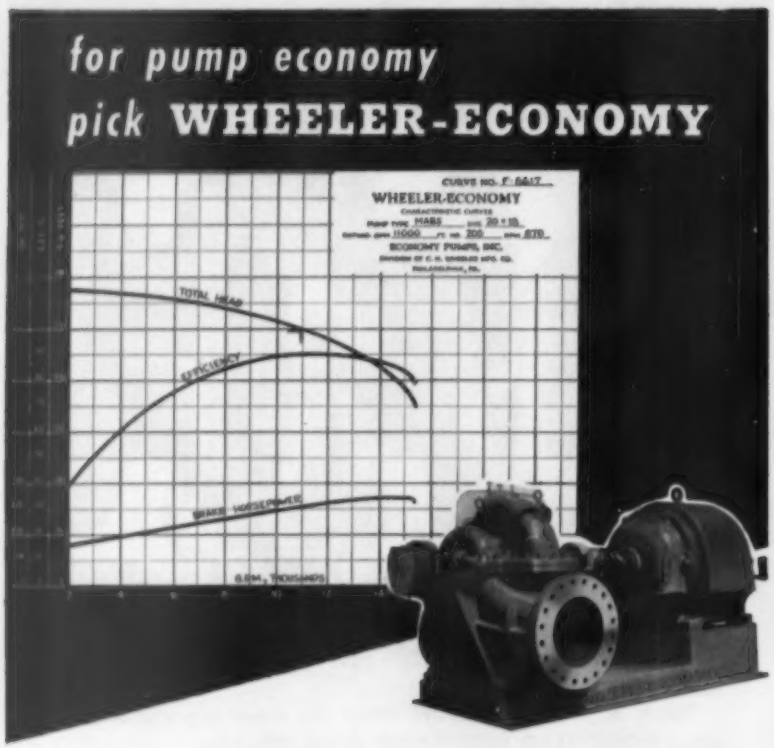
Packless Proportioning Pump

407

Hills-McCanna Co., Chicago, Ill., has introduced a new proportioning pump with no packing, unique high speed valves and pulse free flow. Designated as the "Hills-McCanna-Meter" the new pump is described by the manufacturer as "the meter that pumps" because of its precision pumping and accuracy of control.

The Hills-McCanna-Meter is a packless, positive displacement, fully enclosed unit. Its novel design makes possible a wide output flow range which is easily adjustable by light finger pressure while the pump is operating or stationary.

It is claimed that the pump will precisely meter quantities from 5 c.c. to 6 gallons per hour per feed, dependent somewhat on material being handled. Under actual operating conditions, however, the pump has handled quantities as low as 3 c.c. per hour with good consistency and ability to reproduce the flow. Standard speeds range from 27 to 900 strokes per minute and at the higher speeds and higher capacities particularly, the flow is continuous for all practical purposes. Gases and vapors are vented automatically. Standard units will develop pressures up to 2,500 psig.



The Type M pump shown here is typical of Wheeler-Economy pumps for water works service. Its design embodies heavily ribbed cases and high pressure flange specifications where required. Single or dual volutes are available. Sleeve bearings (oil lubricated) or ball bearings (either oil or grease lubricated) may be furnished in most water works sizes. The pump shown has oil lubricated ball bearings.

Typical performance charts show that high efficiencies over a wide range of operating conditions are yours when you specify Wheeler-Economy.

Catalog BA-1052 illustrates many styles and installations for water works service. Write for your copy.

WE-401

WHEELER-ECONOMY PUMPS

ECONOMY PUMPS, INC. • DIVISION OF C. H. WHEELER MANUFACTURING CO.
19TH AND LEHIGH, PHILADELPHIA 32, PA.

Electronic Free-Vane pH Controller

408

The Bristol Company, Waterbury, Conn., has developed a new electronic indicating pH controller that is available with a variety of electric control actions. Featuring a newly developed high-torque, jeweled, millivoltmeter-type movement, the instrument has an easy to read 7-inch mirror scale, and a dust- and vapor-proof case.

The new controller is available in the following electric control actions: Two-position, Two-position with normal zone, Two-position with proportional-input, and Three-position control. It will actuate a wide variety of final control devices, permitting pH control with any type of reagent, whether liquid, gaseous, or solid.

Remote Indicating Liquid Level Measuring Systems

409

Jordan Electronic Manufacturing Co., Inc., Pasadena, California, has announced a Remote Indicating Liquid Level Measuring System that employs an entirely new principle.

Use of the Neher-White Ionization Chamber and a harmless radioactive source permits these systems to obtain high accuracy indication miles from the point of measurement. Only two connecting wires are required between measuring point and indicating station. Simple inexpensive mercury batteries provide continuous power for one year without replacement.

This inexpensive system requires no amplifiers for Neher-White Ionization Chamber output . . . Output is used directly to drive remote indicating meter or recorder-controller.

Impulse-Duration Telemeter

410

The Foxboro Company, Foxboro, Mass., has introduced a new impulse-duration telemetering system which transmits and receives long distance measurements of process flow, pressure, liquid level, temperature and other variables.

Designed for reliable transmission of measurement in applications such as reservoir level, natural gas line flow and pressure, and intra-plant control systems, the Foxboro Teletax Telemeter can handle distances up to 150 miles by wire or may be operated over radio link or microwave channels.

Because the system operates as a function of pulse duration, the signal level can vary widely without affecting operation or accuracy. At 12-second intervals the telemeter transmitter sends a pulse to the receiver proportional in duration to the variable being measured. The receiver automatically compares the duration of this pulse to that of the previous one and actuates a reversible motor which positions a recorder pen or indicator pointer to reflect any measurement change.

The system uses relatively few moving parts, each of which is easily accessible and can be serviced without special tools. Transmitter, receiver and power pack units are enclosed in rectangular metal cases. Plug-in receiver relays and mercury type switches are used for safe, reliable service.

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all steps from finding water to pump selection covered. Plus important industrial application data.

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Tractor Trenching Unit

411

ARPS Corporation, New Holstein, Wis., has developed the BLACK-HAWK Trench Hog. The Trench Hog is a light weight trenching unit for Ford and Ferguson tractors. It can be equipped with booms 3½′, 5½′ or 7′ in length for digging trenches of such depths.

The machine is offered with standard or slicer cutters for ordinary and sticky soils in widths of 6″ through 20″, or with chisel type cutters for extremely hard and rocky soils in widths of 8″ through 18″. Accessories include a one side dirt delivery attachment, a high speed sprocket for digging narrow shallow trenches up to 800′ an hour, a heavy duty power sprocket for deep and wide trenches, a bulldozer blade for quick backfilling, and crumber attachments for clean, smooth trench bottoms.

Plastic Pipe Cement

412

Merritt Products Company, Cleveland, Ohio, has developed a new ready-to-use cement, Plasjoin VC, for joining rigid polyvinyl chloride pipe.

Formulated in co-operation with B. F. Goodrich Chemical Company, Plasjoin VC has shown in extensive tests that it can be applied easily, sets rapidly and gives tough, positive bond to the joints of rigid vinyl pipe. Pipe joints cemented with new Plasjoin VC are as strong as, if not stronger than, sections of straight unwelded pipe.

The fact that Plasjoin VC comes in ready-to-use form has these advantages for users of this pipe cement: 1) Rigid laboratory controls guarantee uniform quality from shipment to shipment thus eliminating undesirable variations that might occur with uncontrolled small-quantity mixing. 2) Saves the time it would take to prepare pipe cement in the field and avoids the hazards of such preparation. 3) Convenient to use in the field from handy containers of half-pints, pints, quarts and gallons.

Irregularities between the surfaces of rigid vinyl pipe that are being cemented together are compensated for by Plasjoin VC. This assures leakproof joints when the simple directions are followed.

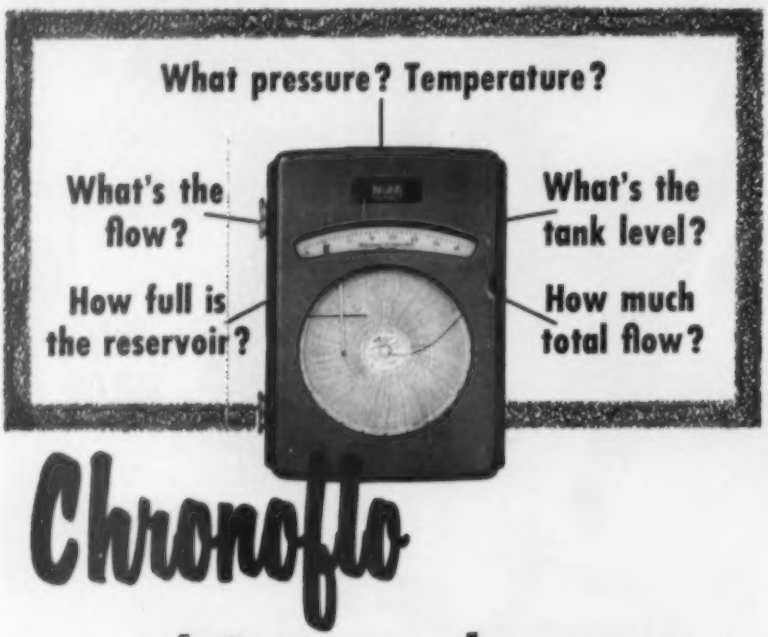
Complete Line of Plastic Pipe

413

The Plastex Co., Columbus, Ohio, is now producing four types of Plastex Measure Marked Pipe to provide the right pipe for every installation.

Pressur Tex, designed especially for high working pressure is available in guaranteed pressure ratings of 75 and 100 lbs. per sq. in. Twin Tex combines two pipes in one unit for fast, easy piping of jet walls. Plastex Standard Wall is the popular all-purpose pipe for general water supply systems, irrigation and drainage. Yello Tex is an easy-to-see pipe for coal mine drainage and industrial wastes or corrosive liquids.

All four types of Plastex Pipe are permanently identified and Measure Marked every 10 feet.



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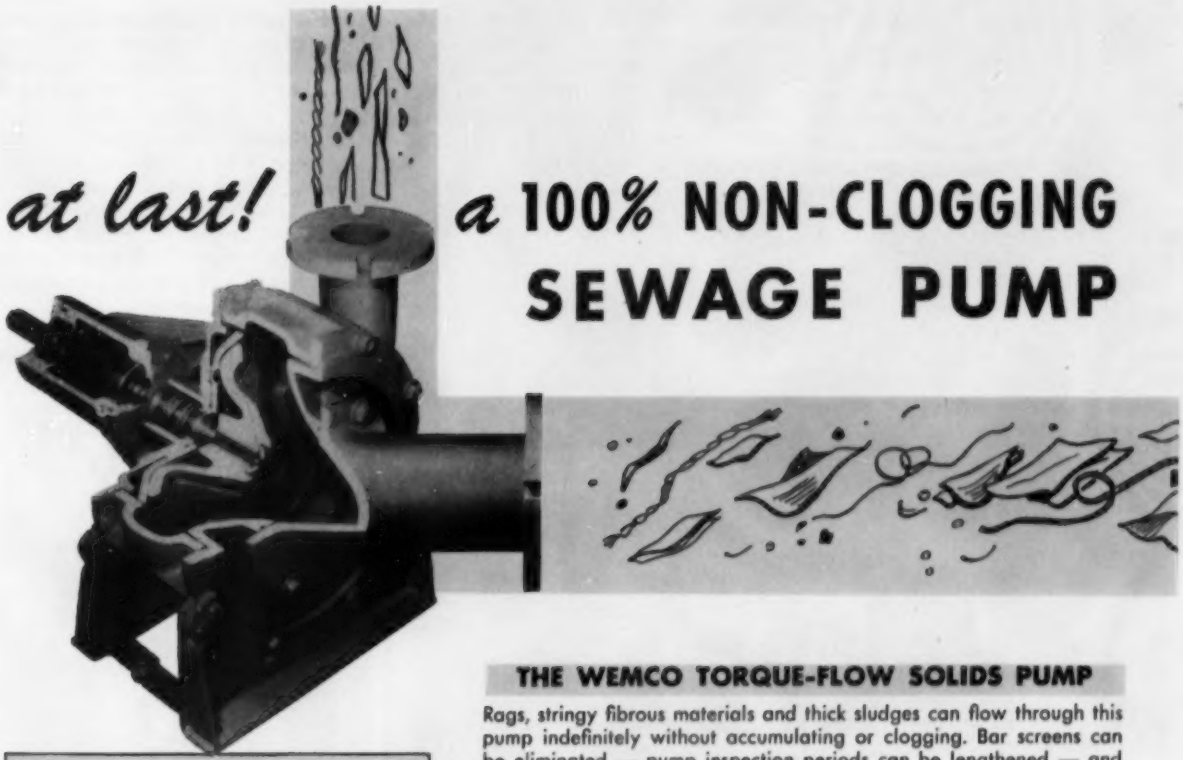

THE WEMCO TORQUE-FLOW SOLIDS PUMP

Rags, stringy fibrous materials and thick sludges can flow through this pump indefinitely without accumulating or clogging. Bar screens can be eliminated — pump inspection periods can be lengthened — and messy pump teardowns become almost a thing of the past.

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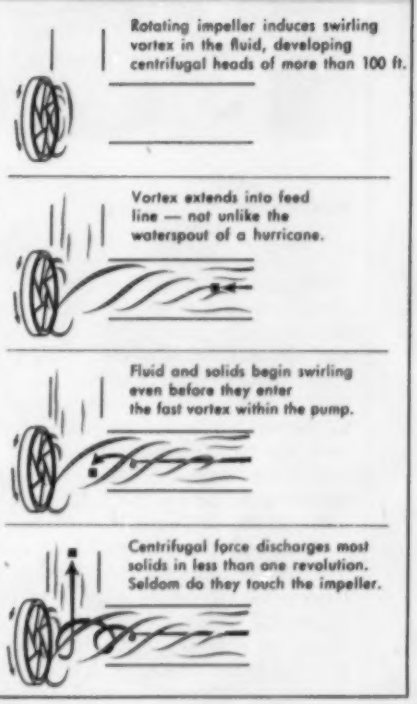
A "hand made" early model Wemco Pump was installed on a 90 day trial pumping raw settled sludge. Previous modern pumps had been ragging-up in excess of four times per week. The trial period was completely successful. Not a single stoppage occurred. Even this hand made model is still in continuous operation after more than fourteen months. This resulted in many additional pumps being installed at other critical points in the system.

COMPLETELY NEW IN CONCEPT

Success of the Wemco Torque-Flow Solids Pump is due to its unique new principle. Nowhere is its flow passage narrower than the discharge — and there are no rag catching projections, corners, or edges. The impeller is recessed from the main flow. It pumps by inducing a vortex and swirl. It will create suction lifts greater than 20 feet or pump heads of 100 feet and more.

Here is how it works


Rotating impeller induces swirling vortex in the fluid, developing centrifugal heads of more than 100 ft.
Vortex extends into feed line — not unlike the waterspout of a hurricane.
Fluid and solids begin swirling even before they enter the fast vortex within the pump.
Centrifugal force discharges most solids in less than one revolution. Seldom do they touch the impeller.

Write for full particulars to Dept.

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• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

An-Spec For Metal Corrosion

414

Pipeline Anode Corporation, Tulsa, Oklahoma, has developed An-Spec magnesium anodes that stop corrosion leaks on gas and water distribution and transmission systems, on pipelines, buried tanks, piers and underwater metallic structures.

According to the company, An-Spec anodes are a practical and efficient means of eliminating corrosion loss. Maintenance free, low cost, anodes are connected and buried alongside the structure to be protected. No outside power is required and there is no danger of electrical interference with other buried structures. Corrosive currents are dissipated by the expendable magnesium anode. An-Spec anodes come in a variety of sizes

Polyvinyl Chloride Valves

415

Hills-McCanna Company, Chicago, Ill., has added to their Saunders Patent diaphragm valve line valves with bodies of polyvinyl chloride (P.V.C.). Coupled with the unique design of these valves, P.V.C. further expands the very extensive list of corrosive materials that can be handled successfully. It also provides a proved and accepted corrosion resistant valve for P.V.C. piping layouts. Hand-wheel operated, lever operated, sliding stem and air operated types are available. Sizes range from ½" through 2". Screwed ends are standard and slip fits are available on special order.

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4-36" Pekrul model 45A Sluice gates at Sacramento Sewage Treatment plant
City managers...engineers... contractors...know that the precision engineering and quality construction of Pekrul Gates means a planned water control project that will fulfill its purpose. It costs no more to plan with quality...specify Pekrul Gates on your next project.
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Levees
Reservoirs
Irrigation
Cooling Towers
Pumping Plants
Water Works
Oil Refineries
Steel Mills
Dams
Fish Hatcheries

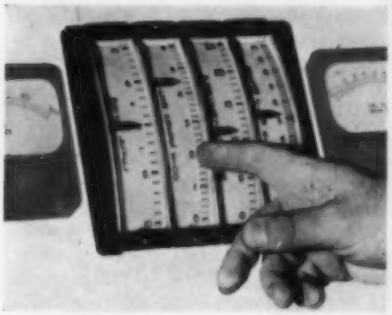
Motor Control Centers

416

General Electric, Plainville, Conn., has announced a new line of General Electric Motor Control Centers which are unusually compact in design.

To be known as DA7093, this new G-E Motor Control Center, according to General Electric engineers, will save up to 50% in floor space. It will take nine NEMA Size One starter units, or six NEMA Size Two units in the standard 90-inch trough without reduction in pull-box space. The starter units will be of either the fusible or circuit breaker types.

Several additional design and construction features have been incorporated in this new line. A new center busing arrangement frees pull-box space for wiring and increases vertical bus capacity from 300 to 600 amperes. This same arrangement also makes available continuous main buses of 600 or 1200 ampere capacity in standard construction up through five sections. The trough is designed to take straight-in wiring to main lugs.

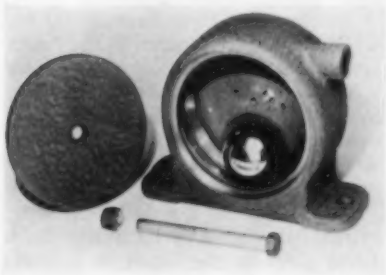


Miniature Remote Indicator

417

The Hays Corporation, Michigan City, Indiana, has developed a miniature remote indicator which has a 5 inch useable scale, and is easy to read. Several desirable features and benefits are incorporated in the indicators. Among these are removable units; easy "one man" zero adjustment; no parallax; internal illumination; and flush or semi-flush panel mountings.

These indicators can be supplied as an electric or pneumatic receiver for the measurement of any function such as pressure, draft, flow, level or temperature. The pneumatic type gage uses as its actuating element a spring-loaded metallic bellows with built-in overpressure protection. The gages can be provided with two units in a single case and two pointers on the single scale.



Vibrator for Hoppers, Chutes, etc.

418

The Viber Company, Burbank, Calif., has developed the AiroViber, a device for moving bulk materials by breaking up arching and jamming in bins, hoppers, chutes, feeders, and other places where bulk materials hang up.

The AiroViber has only one moving part, a steel ball. An air jet blows it at high speed around a round and hardened steel track in the housing. The weight of the ball develops a

(Continued on page 106A)

Sealing Compounds at Work!

PRESSTITE'S *cold applied 3-step sewer joint sealing system*

Prevents Overloading Sewage Disposal Plant

Extensive ground water infiltration can overload planned capacity of the disposal plant, resulting in serious trouble and expense. To prevent this, engineers specified Presstite's 3-step system to seal the recent 17-mile Decatur, Ill., sewer project.

Developed through extensive research, Presstite's economical proven system insures tighter, more dependable joints with three simple steps:

1. Presstite PRIMER . . . painted on bell and spigot ends before laying pipe, provides a better bond.

2. Plus Presstite ROPAX® . . . non-porous packing provides *additional* joint sealing material, forms solid seal impervious to passage of water.

3. Plus Presstite KALKTITE® . . . cold mixed, cold applied asphaltic cement completes sealing. Sets up under the most adverse conditions, forms dense, tough, flexible seal that *keeps water out!*

It's as simple as 1-2-3! You get tighter joints plus saving time and money with Presstite's 3-step system.

PRESSTITE SEALING COMPOUNDS

WRITE TODAY
for 20 page detailed catalog, samples and prices.

PRESSTITE ENGINEERING COMPANY

3780 Chouteau Avenue St. Louis 10, Mo.

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

(Continued from page 105A)

strong centrifugal force, which the vibrator transmits through its mounting into the object to be vibrated. Having no close fitting parts to lubricate or adjust, the AiroViber will start every time the air valve is opened. The speed and amplitude of vibration can be controlled simply by opening or closing the air valve supplying the unit.

Control Valve For Solids

419

Red Jacket Company, Pittsburgh, Penna., has developed a new type of control valve for handling solids in suspension such as sewage, wood and bark particles and other bulky material.

The through flow design of the valve permits unobstructed flow and prevents clogging at the valve. The valve body is made of pure gum rubber and the housing is cast iron. Air is put directly into the valve housing to close or throttle the valve. It is available in sizes ranging from 1 to 24 inches.

Improved Type Of Acid Resistant Paint

420

Speco, Inc., Cleveland, Ohio, has developed an improved type of CHEM-REM, acid and alkali resistant black paint.

The new product is said to have substantially greater covering capacity than its predecessor material. This is reputed to make possible effective one coat coverage, instead of the multi-coat process previously recommended.

Greater water repellence and added lustre through the inclusion of silicone in the paint formula, are other features claimed.

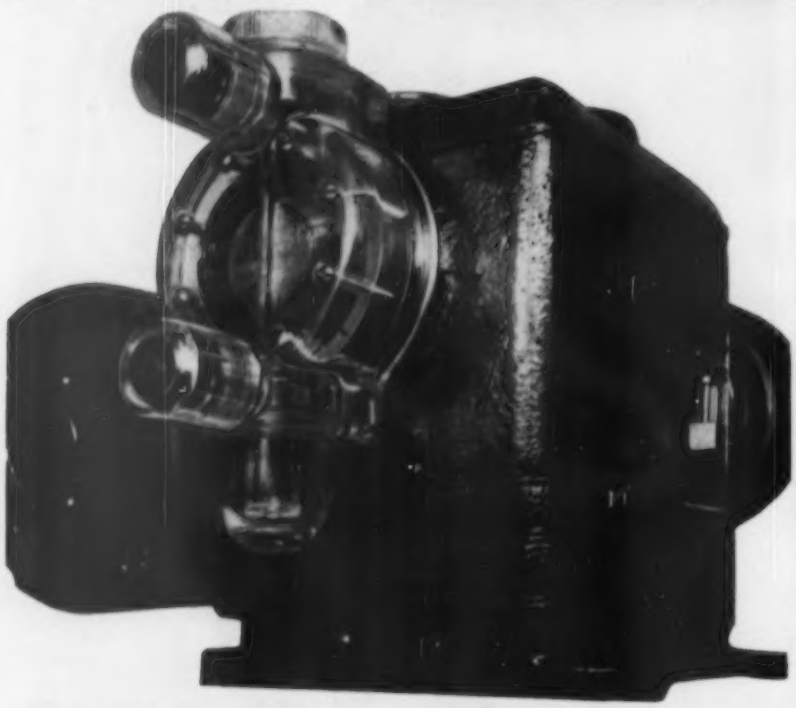
CHEM-REM is recommended for both interior and exterior use on metal, masonry or wood. It withstands attacks of acetic and hydrochloric acids, dilute sulphuric acids, or mixtures of these acids. CHEM-REM is also reputed to protect against the severe action of bleaching solutions, dilute caustic soda, ammonia and other alkalines. It is particularly recommended for locations where smoke and chemical fumes are prevalent.

CHEM-REM can be applied by brush, spray or dip. Its glossy black finish dries to the touch in 3 hours and sets in 10 hours.

Rust Converter

421

Municipal Steel Corporation, chemical division, New York, N. Y., has announced the availability of FerRo-Seal, a liquid which chemically converts rust into a protective iron phosphate coating. New to America, this product is said to be the only cold phosphating treatment for rusted iron and steel. FerRoSeal is a patented process and the registered trade name for one of the products developed by the Walterisation Co., Ltd., of Croy-



THREE GOOD REASONS FOR SELECTING **Chem-O-Feeder**

1. *All-purpose pump* — corrosion-proof measuring chamber safely handles almost all water treating chemicals — at rates from 0.2 to 57 gals. per hour.
2. *Complete kit* — furnished with all necessary items for quick easy installation — easily adapted to all types of constant rate or flow proportional feeding systems.
3. *Maintenance-proof design* — complete feed control mechanism operates in "oil bath" lubrication.

See how Proportioneers Chem-O-Feeder can solve your water treating problems — write for Bulletin 1225. Proportioneers, Inc., 350 Harris Ave., Providence 1, R. I.

PROPORTIONEERS
DIVISION OF B-I-F INDUSTRIES, INC.
BUILDERS IRON FOUNDRY • OMEGA MACHINE CO. • BUILDERS-PROVIDENCE, INC.
BIF METERS FEEDERS CONTROLS

den, England.

According to the distributor, a rusted surface treated with FerRoSeal is a better base for paint or coatings than clean, bright steel, because chemists and engineers admit iron phosphate to be the best known such base. It is claimed that this process eliminates the need for sand or shot blasting, or acid pickling, and requires only the wire brushing off of scale and loose rust. Subsequent water rinsing is also said to be unnecessary because there are no harmful chemicals in FerRoSeal which must be washed off.

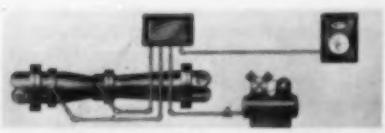
Extension of paint life three to five times by FerRoSeal action as a seal and bond against further rust and corrosion, is claimed on the basis of years of extensive laboratory tests. These include: corrosion examinations, using natural weathering; exposure to various industrial and marine atmospheres; and accelerated tests such as salt spray and/or humidity.

Atlas Introduces New Coatings

422

Atlas Mineral Products Company, Mertztown, Pa., has announced the introduction of a complete line of coatings based on duPont's Neoprene. This line consists of Neobon, an on-the-job mixed heavy rubber coating; Neelium, a high solids high built liquid Neoprene coating; a caulking material and Elprene, a liquid Neoprene maintenance coating. These products which are available in gray and black colors can be applied to metal or concrete surfaces over a Neobon priming system.

Neobon or Elprene may be applied by brush, roller coater or spray gun.



Remote Pneumatic Transmission Instrument

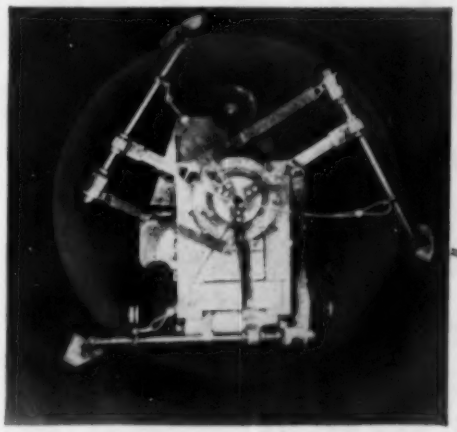
423

Simplex Valve and Meter Company, Philadelphia, Pa., has designed the Laminair, a device that permits the location of instruments at greater distances from the primary devices without regard for hydraulic elevations at the point where the instruments are located.

The Laminair, is a mechanism which balances a single air pressure against any differential pressure produced by a venturi tube, flow nozzle, orifice plate, or the difference between two existing levels or pressures, which pressure is then transmitted and used by a distantly located instrument.

The device is composed of two main groups of mechanism. The first is the differential converter which converts the fluid pressure to air pressure. The second is the bellows type receiving mechanism which translates air pressure into terms of measurement for application to a flow or pressure indicating or recording instrument.

Since the air consumption for each converter averages only 0.1 cfm of free air, the Laminair is economical in action. A small self-contained air compressor having but a few cubic feet capacity will be sufficient for the average small community filter plant or an average meter installation.



CENTRILINE goes to CUBA

The Centriline process has been selected by Municipio de la Habana to play an integral part in the expansion of this city's water supply system. Over 114,000 feet of new welded steel pipe, ranging in diameters from 30" to 78", will be cement-mortar lined in the near future.

In this process, the novel machine illustrated above is drawn through the pipe while cement-mortar is centrifugally sprayed on the pipe walls and troweled smooth by the rotating arms. Mortar thickness is controlled by the speed of the entire machine. Because the pipes remain in place throughout the process, traffic interruption is cut to a minimum; time and money are saved.

Whether you're expanding or rejuvenating your water system, follow the lead of progressive city officials and engineers around the world. Call on Centriline to add years of new life to your water supply lines.

Supervising engineer on the project is Francisco Pividal, C. E.; Chief Engineer is Adrian Macia, C. E.; General Contractor: Comp. Constructora M. A. Gonzales del Valle, S. A.; Pipe Contractor & Manufacturer: Tuberia de Concreto Universal, S. A.

CENTRILINE CORPORATION

A subsidiary of the Raymond Concrete Pile Company

140 CEDAR STREET
NEW YORK 4, N. Y.

Branch Offices in Principal Cities of the United States and Latin America

• CEMENT-MORTAR LINING OF PIPES IN PLACE •

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Low-Cost Rust Control

424

Inertol Co., Inc., Newark, N. J., has available Rustarmor, a long-oil alkyd protective paint that provides low-cost rust control.

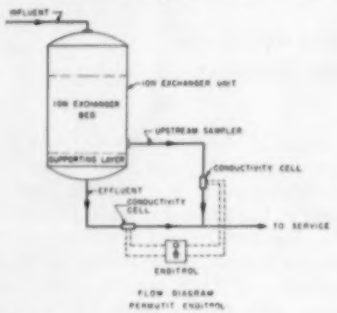
According to the company, Rustarmor saves money, time and labor in painting steelwork, metal buildings, equipment, tank exteriors, fences and other nonsubmerged metals by making sandblasting to bright metal unnecessary. All that is required is the removal of loose rust and foreign matter. Rustarmor soaks right through rusted areas and bonds to the solid steel beneath. Moisture in the rust is actually expelled by it so that further rusting is stopped.

Rustarmor comes in 13 fade-resistant industrial gloss colors. Coverage: 500-600 square feet per gallon per coat. Covers most surfaces in one coat after spot priming with Rustarmor primer.

Endpoint Indicator For Cation Exchanger

425

The Permutit Company, New York, N. Y., has developed a new electronic control to take advantage of the fact that as the downflow hydrogen zeolite ion exchanger approaches exhaustion, the hydrogen concentration of the effluent has a higher conductivity than that of the upstream sample. Called the Enditrol, endpoints of the ion exchange run can be simply determined by comparing the conductivities of the upstream sample and the effluent.



FLOW DIAGRAM PERMUTIT ENDITROL

Equipped with proper electrical controls, this device can also be used for automatically initiating the operation of existing automatic regeneration equipment. Operation of such units could be made entirely automatic and would eliminate the dangers of over-running and the chemical and water wastages caused by underrunning. The Enditrol may also be equipped with a relay so that it can signal the end of the operating run by an alarm bell or light arrangement.

In operation, a continuous flow of water is drawn from the upstream tap and comparison of this tap water with the effluent results in a ratio that is constant until the resins approach exhaustion. The decrease in acidity moves downward during the run and when it reaches the tap, the ratio suddenly changes. This change in ratio signals the end of the run.

This control device is equally applicable to anion exchangers used for silica removal where the anions are taken up in a preferential manner by the ion exchanger bed.

a summer problem will be no problem

if you call in National now!

If last summer's peak demands created low pressure problems in your water distribution system call National for a *free survey* on how water main cleaning will uprate your system.

You'll find as have other leading communities that National cleaning is an investment—not an expense. National cleaning is so effective that *restoration of at least 95%* of the original capacity of your mains is guaranteed!

Charges are modest with little if any interruption to service. So, for compliments instead of complaints why not call National right now?

Call in National today!

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Corrosion Resistant Protective Coating

426

Alfred Hague & Co., Inc., Brooklyn, New York, has available Rubalt Ra, a black corrosion resistant paint that looks like patent leather and has a rubbery feel.

A combination of chlorinated natural rubber and bitumen, together with modifiers and appropriate solvents, the general characteristics of Rubalt Ra are: extreme non-porosity; great flexibility; maximum adhesion; resistance to many acids and alkalies; non-flowing under heat; requires no primer or pre-treatment; low and high temperature resistance; and one gallon will cover 756 square feet to a thickness of 0.001 inches.

Portable Masonry Hole Cutting Machine

427

The Molco Drilling Machines Corp., Washington, D. C., has developed a new masonry hole cutting machine that is portable, operates at high speed, and is light weight.

The machine, called a "Mechanized Mole", uses a self-sharpening diamond drilling bit to cut holes ½ to 10 inches in diameter through hard aggregate, including any steel reinforced building material, to a depth of 18 inches. Deeper holes may be drilled by placing an extension shaft on the bit. Drilling time of a six inch diameter hole in one foot of concrete is less than 2 minutes.

AFTER 28 YEARS' SERVICE—

In 1925, The Board of Water Supply, city of Providence, laid a water line in Cranston, Rhode Island. Interior surfaces were hand-brushed with hot Bitumastic® Enamel.

This illustration is graphic proof of the extra value you get when you specify Bitumastic Enamel. After 28 years' continuous service, a section of this 48-inch line was removed for inspection.

Note that there is no sign of rust or tuberculation. Brush marks are still visible. The original coefficient of flow has been maintained over the years. With such performance available from Bitumastic Enamel, there is no need to specify over-sized diameter pipe, thus giving important installation as well as operational economies.

Samples of this original 28-year-old Bitumastic Enamel lining were tested. Laboratory analysis showed there was practically no change in the characteristics of the Bitumastic Enamel. This gives every reason to believe that the line will continue to give the same type of dependable performance for many more years.

Service records like this prove that it pays to use strong steel pipe, protected by Bitumastic Enamel. It's an economical combination for your large-diameter water lines. Write for full information.

SEWAGE EQUIPMENT PROTECTION!

Koppers also makes Bitumastic® Protective Coatings for all kinds of sewage-plant equipment. Give your expensive equipment the effective protection it deserves. Write for complete data.

KOPPERS BITUMASTIC® ENAMELS

KOPPERS COMPANY, INC., Tar Products Division

Dept. 461-T, Pittsburgh 19, Pennsylvania

DISTRICT OFFICES: BOSTON, CHICAGO, LOS ANGELES, NEW YORK, PITTSBURGH, AND WOODWARD, ALA.

W&SW

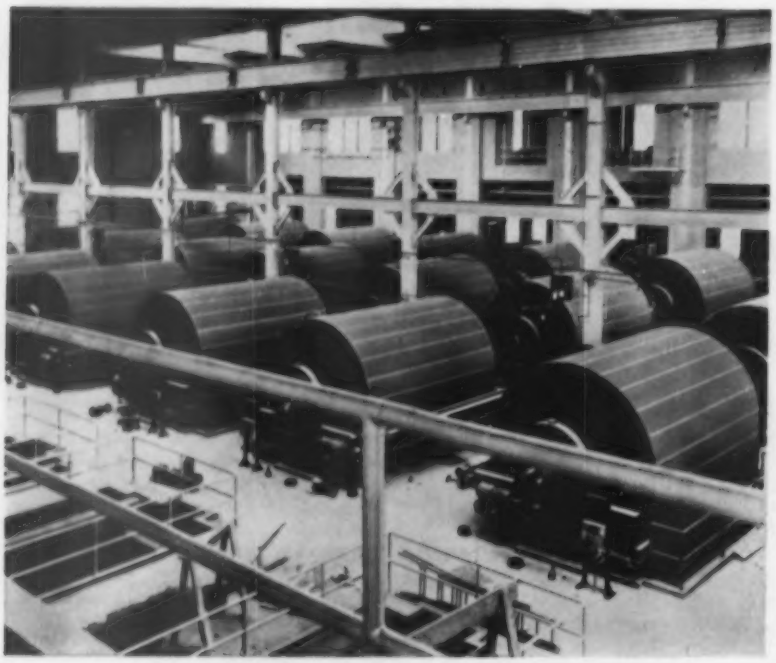
Manufacturers' News

Robertshaw-Fulton Opens New Sales Office

The Fielden Instrument Division, Robertshaw-Fulton Controls Company, Youngwood, Pa., has announced the opening of a new sales office, operating directly from the division's plant, and it will distribute all Fielden products in metropolitan Philadelphia and eastern Pennsylvania.

The division, manufacturers of industrial instrumentation and a variety of electronic devices, has terminated by mutual agreement its arrangements with Sheffler Gross Company, which formerly served as manufacturer's representative in the area.

The Company also announced the appointment of Ross Kemmerly and Roger Wernlund to the sales staff of the new Philadelphia office. Mr. Wernlund will handle government and sub-contract negotiations.



Get higher efficiency from your vacuum filters with Pennsalt Ferric Chloride

Pennsalt Ferric Chloride provides *maximum* coagulating and flocculating action *over a wider pH range* than other coagulants used in dewatering sludge by vacuum filtration. This *more effective* action reduces the load on your filters . . . increases the yield per filter . . . holds filter downtime to a minimum . . . gives you a drier, easier to handle cake.

Whether you run a large plant, or a small community operation, it pays to use Pennsalt Ferric Chloride. It is available in two easy-to-use forms: anhydrous $FeCl_3$ in drums, or a concentrated aqueous solution in tank cars. For further information on Ferric Chloride and its use in conditioning sewage, call our nearest District Office. Or write: Industrial Chemicals Division, Pennsylvania Salt Mfg. Co., 981 Widener Bldg., Philadelphia 7, Pa.

Pennsalt District Offices

Appleton, Wis.—Appleton 3-9307
Atlanta, Ga.—Vernon 0241
Chicago 1, Ill.—Andover 3-6170
Cincinnati 2, Ohio—Main 3168
Cleveland 15, Ohio—Main 1-6205
Detroit 26, Mich.—Woodward 1-8051
Paterson 1, N.J.—Lambert 5-3500
Philadelphia 7, Pa.—LOcust 4-4700
Pittsburgh 19, Pa.—Atlantic 1-5233

Pennsalt Chemicals

Barrett Appoints Stupp Vice President

Barrett Division, Allied Chemical & Dye Corporation, New York, N. Y., has announced the appointment of C. G. Stupp to the position of vice president.

Mr. Stupp has been technical director of Barrett since 1951, during which time the Division's research and development activities have doubled. He was first employed by Barrett 38 years ago as a research chemist in the Edgewater plant, and has held positions of increasing responsibility in manufacturing and research since then. Born in Auburn, N. Y., he is a graduate of Cornell University.

Mr. Stupp will continue to head technical activities of the Division, including the extensive research and development department with modern laboratories in Edgewater, N. J., Glenolden Pa., and Toledo, O.

Gar Wood Promotes Brown

Gar Wood Industries, Inc., Wayne, Mich., has appointed Leo M. Brown assistant to the director of sales and advertising.

Brown's appointment follows his return to Gar Wood after working several months as Western sales manager for Galion Allsteel Body Company.

Brown formerly was sales manager of Gar Wood's St. Paul Hydraulic Hoist division. He has served the company in various sales capacities since 1949, when he was employed as a salesman for Gar Wood in the South Central States. He was trans-

ferred to St. Paul Hydraulic Hoist in 1950 as district manager and subsequently became assistant sales manager and then sales manager.

Before joining Gar Wood, Brown was employed as a construction engineer for E. I. Dupont in the Southwest and as sales manager for Truck Equipment Company, St. Louis, Mo.

New Company to Manufacture Paul Valves

P. K. Industries, Inc., manufacturing engineers, North Arlington, N. J. has announced that it has acquired a non-exclusive contract with the Paul Valve Corporation for the manufacture and sale of the Paul Venturiball valve.

A merger of operations between several manufacturing and engineering companies, who have recently organized under the P-K name, makes available greatly expanded facilities for the manufacture and sale of Paul Venturiball valves as well as other valves of a specialized nature.

Just recently, a new plant was opened in North Arlington, N. J., where the Paul valve will be manufactured and sold under the P. K. label. In addition to excellent machine facilities, P. K. Industries is unique in the valve industry in having its own investment casting foundry for precision casting of vital working parts as well as a mechanized "Stelliting" department for hard facing critical wear points of the P. K. valves.

Le Roi Names Permar Field Sales Manager

Le Roi Division of Westinghouse Air Brake Company, Milwaukee, Wis., has named Don S. Permar to the newly created post of field sales manager. General sales manager Jack E. Heuser said that Permar will have overall responsibility in managing the Le Roi field sales organization.

Permar moves on from his position as sales manager of stationary air compressors. He served for five years in the Army Air Force after attending Carnegie Institute of Technology. In 1945 he joined Westinghouse Air Brake as a pneumatic engineer. In the fall of 1946 Permar became a special representative for the Industrial Products Division.

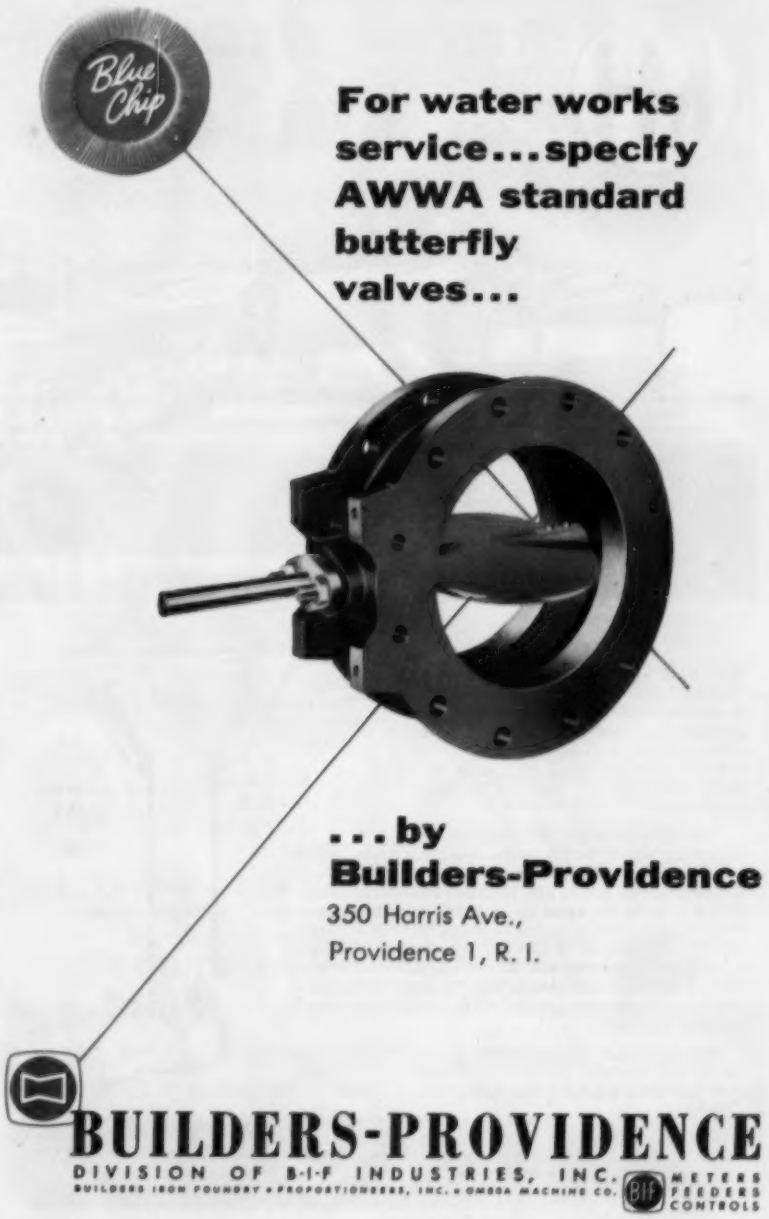
Emsco Buys Johnston Pump

Johnston Pump Company, Pasadena, Calif., has announced the sale of that company to the Emsco Manufacturing Company, Los Angeles, California, of most of the assets of Johnston Pump Company.

Emsco is one of the foremost manufacturers of oil country drilling and pumping machinery and equipment. Approximately eighty-five percent of the outstanding stock of Emsco is owned by Youngstown Sheet and Tube Company and its wholly owned subsidiary, Continental Supply Company.

Johnston Pump Company was founded in 1909 and has grown to be the largest independent vertical turbine pump manufacturer in the world, with its main plant in Pasadena, and manufacturing facilities in Mexico and India. Johnston Pumps are widely used by agriculture and industry throughout the world.

It is the intention of Emsco to operate Johnston substantially in the same manner as in the past.



Homelite Promotes Two

Homelite Corporation, Port Chester, N. Y., has announced the election of Richard C. McDonald as Vice President in Charge of Manufacturing, and Albert K. Newman as Vice President in Charge of Engineering.

Mr. McDonald is a graduate of Michigan State College and was formerly associated with the Ford Motor Company's manufacturing division. He joined Homelite as a salesman in 1937, was made manager of the Chicago sales office in 1939 and transferred to the engineering department in 1941. Two years later he became Assistant Factory Manager, and was appointed Homelite's Factory Manager in 1946.

Mr. Newman has been Homelite's Chief Engineer since 1948. He attended Washington and Lee University in Lexington, Virginia, and holds a Bachelor's and Master's degree in Electrical Engineering from Massachusetts Institute of Technology. In 1942, Mr. Newman joined the Homelite Corporation as a project engineer after sixteen years as design engineer with the Electric Specialty Company of Stamford.

R. M. Gwynne Appointed by B-I-F Pacific

B-I-F Industries, Inc., Providence, R. I., has announced the appointment of Mr. Robert M. Gwynne to the post of Sales Engineer for the Los Angeles office of B-I-F Pacific. Mr. Gwynne's experience with B-I-F Industries includes positions as serviceman, repair parts manager, assistant service manager, and exhibit manager.

Bailey Meter Opens Dallas and Memphis Offices

Bailey Meter Company, Cleveland, Ohio, has announced the establishment of new district offices in Dallas, Texas, and Memphis, Tenn.

F. D. Krusemark is manager of the Dallas office, located at 6331 Aberdeen Ave., Dallas 30, Texas. The Memphis office is under the managership of R. E. Byers, and is located at 3256 Hendricks Ave., Memphis 11, Tenn.

The Dallas district covers the territory of northern Texas and northwestern Louisiana. The Memphis district includes western Tennessee, northern Mississippi, and the state of Arkansas.

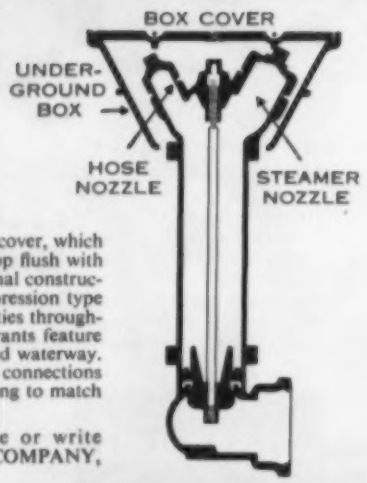
Ludlow Valve Buys Rensselaer

The Ludlow Valve Manufacturing Co., Inc., Troy, N. Y., has purchased the product line, patterns, inventories and business of the Rensselaer Valve Co., Cohoes, N. Y., for an undisclosed sum. The purchase brings together, under one management, two of the oldest and most reputable manufacturers of quality valves and fire hydrants used in the water works field and in the oil and gas industries.

Oliver F. Gang, president and general manager of the Ludlow firm, and Lyman C. Thunfors, president and general manager of the Rensselaer company, made the announcement jointly.

The announcement stated it is planned to continue production at the Cohoes, N. Y., plant for "some months," but that gradually equipment from that plant would be transferred to the Ludlow shops at Troy, N. Y., which will continue the manufacture of the entire line of Rensselaer products.

This M & H Hydrant sets completely underground. The cast iron box cover is on line with the ground level, thus completely eliminating any interference with traffic. M & H flush type hydrants are especially designed for use at airports servicing the heaviest modern airplanes.



The operating nut and nozzles are accessible simply by lifting the two piece cover, which has disappearing handles designed to drop flush with the cover when not in use. Hydrant internal construction is exactly the same as M & H compression type fire hydrants used by so many municipalities throughout the country. M & H flush type hydrants feature a 5¼" valve opening and an unobstructed waterway. Can be supplied with one or two fire hose connections and/or with steamer nozzle, with threading to match existing standards.

For additional information, wire or write M & H VALVE AND FITTINGS COMPANY, ANNISTON, ALABAMA.

M&H PRODUCTS FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION

Conoflow Promotes Holben

Conoflow Corporation, Philadelphia, Pa., has announced the appointment of Ralph G. Holben as Vice President in Charge of Manufacturing.

Mr. Holben, formerly Plant Manager, will be responsible for the supervision of Production, Purchasing and Maintenance of plant facilities.

Mr. Holben's promotion is in line with Conoflow's policy of continually attempting to develop a closer integration and coordination of top management activities. It is also a direct result of Conoflow's rapid growth and broad expansion in the field of automatic controls.

American Meter Acquires Philadelphia Pump

The Philadelphia Pump and Machinery Company, Inc., Philadelphia, Pa., has announced that it has become a subsidiary of American Meter Company.

The president of the company remains Joseph A. Eagan. Vice-president is Wm. G. Hamilton, Jr. Secretary and treasurer, William Ashby.

According to Mr. Eagan, many new lines of chemical pumps and controlling equipment will be introduced.

The principal office of the company is located at 1513 Race Street, Philadelphia.

Electro Rust-Proofing Opens Atlanta Office

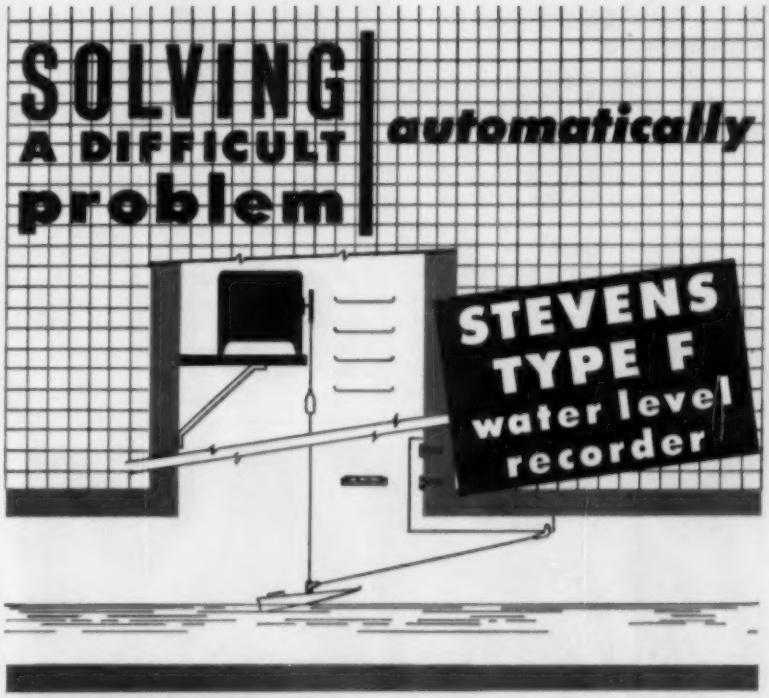
Electro Rust-Proofing Corporation, Belleville, N. J., announced the opening of a new division office at 3 Rhodes Center, N. W., Atlanta, Ga., under the supervision of R. B. Mills, Divn. Mgr., and L. A. Lehmann, Divn. Engr.

Located to strengthen the Southeast leg of a nationwide corrosion control service organization, the Atlanta office will serve North and South Carolina, Kentucky, Tennessee, Mississippi, Alabama, Georgia and Florida.

Simplex Valve Moves

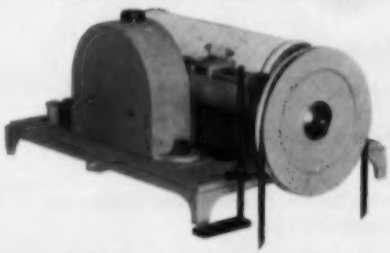
Simplex Valve & Meter Company, Lancaster, Pa., has announced that they are moving from their offices at 68th & Upland Streets, Philadelphia 42, Pa. Their new address will be 7 East Orange Street, Lancaster, Pa.

According to Mr. E. M. Jones, Vice President and General Manager, "This move to larger quarters will enable us to service our customers better than ever before. In addition, we have created a new Philadelphia Sales Division with quarters at the present Philadelphia address."



PROBLEM: To obtain automatic, graphic records of the flow of sewage in a sewer main without the expense of installing a weir and float well.

SOLUTION: Install a STEVENS Type F Water Level Recorder mounted on a bracket in a manhole. Use a scow float to operate the recorder and make a stage-discharge rating of the flow. Or, following construction details and rating tables we provide, also install a STEVENS critical flow control down stream to establish a positive depth-flow relationship.



The planning and efficient operation of any project which involves measurement of flowing liquids is based on flow data which can be obtained with STEVENS water level recorders. STEVENS instruments are at work compiling data on hydroelectric and flood control projects, and in water works, sewage disposal plants, irrigation and industrial installations in all parts of the world.

STEVENS DATA BOOK

...Invaluable for your reference file

144 pages of technical data on recorder installations... plus a wealth of hydraulic tables and conversion tables.

Send $1.00 (No COD's)

LEUPOLD & STEVENS INSTRUMENTS, INC.

4445 N. E. GLISAN STREET • PORTLAND 13, OREGON

Foremost in Precision Hydraulic Instruments Since 1907

Executive and Sales Promotions at Atlas Mineral

The Atlas Mineral Products Company, Mertztown, Pa., has announced the following changes and promotions:

Joseph A. Snook, from Vice President to Executive Vice President; Eugene Kirkpatrick, from Eastern Regional Sales Manager to General Sales Manager; George Gabriel, from Engineering Manager to Manager of Manufacturing; Gerald F. Gilbert, Jr., from Sales Coordinator to Treasurer and Purchasing Agent; George L. Wirtz, Jr., from Purchasing Agent to Manager of Product Planning; and Kenneth T. Snyder, from Western Regional Sales Manager to Assistant Sales Manager.

The following new appointments have been made in the Atlas sales force: John Swift, from Furnane Sales Engineer to Pacific Coast District Manager; James Ohman, Houston District; Robert Spencer, St. Louis District; Erik Van Anglen, Philadelphia District; Martin Smith, New York District; Thomas Price, Boston District; John South, Detroit District; and Frank Beauchner, Cincinnati District.

Vacuum Pressure Pump Cat. XX 60 000 00 | Hydrosol Standard Filter Holder with Sterilization Base and Cover Cat. XX 20 047 00 | Millipore Filters (Box of 100) | Plastic (Disposable) Petri Dishes (Box of 10)

MILLIPORE MF FILTERS

In the analysis of • Bacterial Contaminants • Total Counts • Coliforms • Soil Organisms

ACCURACY — The MF® has been described as the equivalent of six (6) 5-tube MPN's.*

SENSITIVITY — The isolation and identification of specific pathogens by the MF is often possible when other methods fail.†

RELIABILITY — Reproducible results occur time after time. Standard deviation less than half that of MPN. $\sigma_{MF} < \frac{\sigma_{MPN}}{2}$

LESS COSTLY — The reduction in cost per test permits wider and more frequent monitoring of water supplies for corrective action.

MORE RAPID — Total counts in as little as four (4) hours; confirmed tests in sixteen hours versus three to four days with other methods.

SIMPLE TO USE — Routine analyses require no extensive training in operation or in interpretation of results.

A comprehensive summary of literature in many new techniques and a complete line of accessory equipment are available from the laboratories of the

MILLIPORE FILTER CORPORATION
Watertown 72, Mass., U. S. A.

*Woodward, 1952, BHC Activity Report 11.13 Jan.-Mar.
†Collet, Johnston, Ey, Croft, 1953 J. Amer. Public Health Assn. 43:1438-40 November.

Hammond Iron Works Plans Expansion

Hammond Iron Works of Warren, Pennsylvania, has announced that a tentative agreement has been made with Henry Sears & Co. of New York to form a new company as yet unnamed which will carry on and expand the present business, products and facilities of Hammond Iron Works.

The new company will be built around the present Hammond personnel, organization and facilities and will be augmented to provide greater service to general industry, particularly in the Petrochemical, Processing, Water Works and Utilities fields.

Hammond Iron Works, a Pennsylvania corporation, was organized in 1900 and has been in business continuously since that year. It now has plants in Warren and Bristol, Pennsylvania, Birmingham, Alabama, Provo, Utah, and Casper, Wyoming.

Vanton Moves to Hillside, N. J.

Vanton Pump & Equipment Corp., New York, N. Y., has announced the removal of its executive and sales offices to its plant location at 201 Sweetland Avenue, Hillside, New Jersey. According to George Black, Public Relations Counsel, this consolidation of management, sales and engineering activities is the result of expanded production and research facilities at Hillside and the stepped up program of product development both of which have demanded much closer liaison and communications.

Bulkley, Dunton Appoints Canadian Representatives

Bulkley, Dunton Processes, Inc., New York, N. Y., has announced the appointment of Jean Paul Rolland of Montreal and Charles E. Napier Company, Ltd., of Toronto, as the firm's representatives in Canada.

The New York firm, manufacturers of Colloidair Separators for the clarification of waste and process waters for industrial and commercial uses, made the move as part of a planned program to give more intensive sales and service coverage to Canadian industry.

According to W. L. Krapf, Manager, the Napier Company, Ltd. of Toronto will represent Bulkley, Dunton in Central Canada, while Jean Paul Rolland, Montreal, will cover all industries in Eastern Canada for the firm.

New Subscription Order Card

Water & Sewage Works

185 NORTH WABASH AVE. CHICAGO 1, ILL.

Gentlemen:

Please enter my new subscription to WATER & SEWAGE WORKS for the period checked below:

☐ Three Years—$6.00 ☐ Two Years—$4.50 ☐ One Year—$3.00

Above rates are for U.S.A. and Canada. Add $1.00 per year for other countries.

Name ..... Title or Position .....

Company or Govt. Dept. .....

Address .....

City ..... Zn. ..... State .....

NOTE THE NUMBERS
they correspond with the
headings in our
EQUIPMENT AND LITERATURE COLUMNS
To receive further information
on any of the listed
EQUIPMENT OR LITERATURE
just circle the corresponding
numbers on the card
Fill in your name, address, title
and mail!
For your convenience these
cards require no postage.

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IF YOU WISH TO RECEIVE FURTHER INFORMATION ON PRODUCTS ADVERTISED OR REFERRED TO IN THE ARTICLES, OF THIS ISSUE—LIST THE PAGE AND ITEM BELOW.

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Company or Dept. .....

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*ITEMS LISTED NOT SERVICED AFTER JUNE 30, 1955

No Postage Stamp Necessary If Mailed In the United States

BUSINESS REPLY CARD
First Class Permit No. 43608, Sec. 34.9, P.L.&R., Chicago, Ill.

WATER & SEWAGE WORKS
185 NORTH WABASH AVENUE
CHICAGO 1, ILLINOIS

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BUSINESS REPLY CARD
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WATER & SEWAGE WORKS
POST OFFICE BOX 35
VILLAGE STATION
NEW YORK 14, NEW YORK

Postage Will Be Paid By Addressee

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for
WATER & SEWAGE WORKS

JUST CLIP THESE CARDS MARK AND MAIL— TO RECEIVE THE LATEST INFORMATION OR LITERATURE DESCRIBED IN THIS ISSUE

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Equipment — Products
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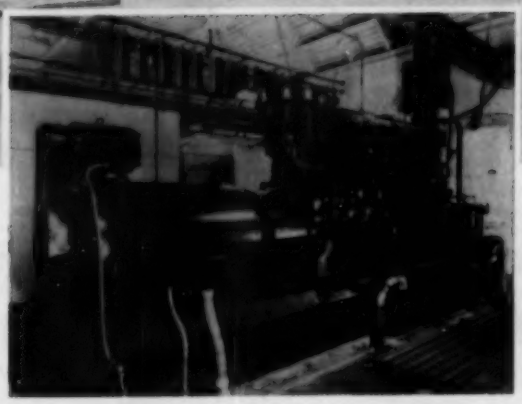


This Model 40-S-8 Superior Diesel is rated at 435 hp at 900 rpm. It protects Attleboro's 24,000 citizens by being ready to supply their water needs, including fire protection, for long periods of time.

Power failure no longer threatens Attleboro's water supply

Not long ago, frequent power failures stopped vital city water pumping in Attleboro, Mass. Experiencing five or six such failures per year, city officials acted to assure the community a continuous water supply. They installed a generator set powered by a heavy-duty Superior Diesel model 40-S-8 to provide power during such failures.

As Mr. Russel F. Tennant, Supt. of Public Works, stated...they needed an engine that would "stay in there and deliver!" It didn't take long to realize the value of their new Superior Diesel. When hurricane "Carol" hit Attleboro last year, causing a million dollars worth of damage, the central station power was lost almost immediately. Superior power went right into action.

For two full days this Superior carried the entire load for pumping and building lighting. Result: "All operating routine was carried through splendidly." In referring to this emergency situation Mr. Tennant said, ". . . we certainly are proud and of course relieved, to own this engine and generator of proven worth."

Whatever your power generation requirements, be sure you have all the facts on National Supply's complete line (4 to 1765 hp) of Superior, Atlas and Lister Diesels. Write or call Engine Division offices in Springfield, Ohio, or contact the nearest sales and service point listed below for complete information.

DIESEL DUAL FUEL GAS

ATLAS Superior DIESEL ENGINES

Superior ENGINES

DISTRIBUTOR OF Lister DIESELS IN U.S.A.

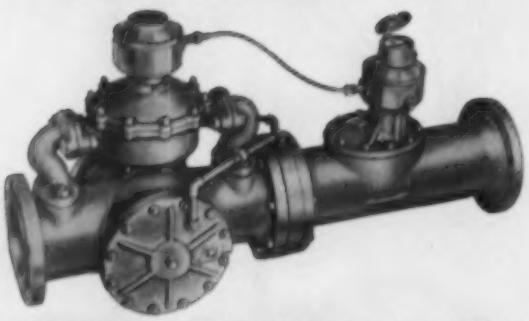
THE NATIONAL SUPPLY COMPANY

ENGINE DIVISION PLANT AND GENERAL OFFICES: SPRINGFIELD, OHIO

SALES AND SERVICE POINTS: Gloucester, Massachusetts • Houston, Texas • Fort Worth, Texas • San Diego, California Oakland, California • Terminal Island, California • Ketchikan, Alaska • Washington, D.C. • Chicago, Illinois • Portland, Oregon • Astoria, Oregon • Casper, Wyoming • St. Louis, Missouri • Halifax, Nova Scotia • Vancouver, B. C. • Park Rapids, Minnesota • New York, New York • Seattle, Washington • New Orleans, Louisiana • Pittsburgh, Pennsylvania

SPARLING

WATER CONTROL EQUIPMENT



BROAD-GAUGE COMPOUND METERS

accurately register flows over 1 to 1000 range

Where extremely low flows in main-lines must be logged, the SPARLING BROADGAUGE is ideal! On a 6-inch line, for example, flows of 900 GPM—or more—are measured with practically no head loss, while flows of 2 GPM are logged accurately, too.

The compound valve opens automatically and closes by line pressure. A transmitter can be added for remote indication, recording, or for auto-metered control of chemical feeds. Available in sizes 6", 8", 10" and 12".

Your request for CF-333 brings full information.

SPARLING METER COMPANY

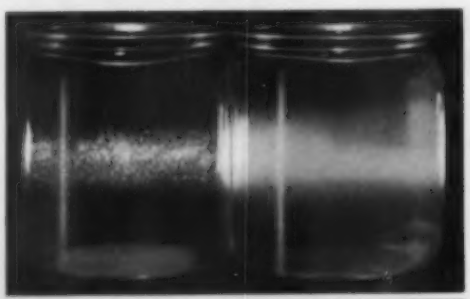
ATLANTA 3.....66 Luckie Street NW
BOSTON 8.....6 Beacon Street
CHICAGO 8.....1500 South Western Ave.
CINCINNATI 2.....626 Broadway
DALLAS 1.....726 Reserve Loan Life Bldg.
6 E. Eleventh St.....KANSAS CITY 6, MO.
Box 3277.....LOS ANGELES 54
3530 Forbes St.....PITTSBURGH 13
101 Park Avenue.....NEW YORK 17
1932 First Avenue.....SEATTLE 1
207 Queens Quay West.....TORONTO, CAN.

N-Sol® Processes

settle water clarification problems

fast

Floc formed by N-Sol Activated Silica Sol and your regular coagulant is large, bulky and strong, settling rapidly to produce clear, sparkling water. Choose the N-Sol Process coagulant aid to fit your operation. No charge for license under N-Sol patents.



PROCESS	REACTANT	ADVANTAGE
N-Sol-A (U.S. Pat. 2,444,774)	Ammonium sulphate	Ease of preparation, either batch or continuous. Facilitates the production of chloromines for sterilization.
N-Sol-B (U.S. Pat. 2,310,009)	Alum	Reactant readily available, inexpensive.
N-Sol-C (U.S. Pat. 2,567,285)	Chlorine	Reactant usually available where sterilization is normal practice.
N-Sol-D	Sodium bicarbonate	Used where a highly alkaline salt is desired. For boiler feed water where ammonia is not desired.

Activated silica sol is made in your plant from our N® Sodium Silicate shipped in drums or tank cars.

Sample of N Silicate and data sheet on jar test procedure on request.

Philadelphia Quartz Company
1166 Public Ledger Bldg., Philadelphia 6, Pa.

N-Sol® Processes
PQ® SOLUBLE SILICATES

New Chicago Office and Sales Personnel Shifts for Darling Valve

Darling Valve & Manufacturing Co., Williamsport, Pa., has announced the establishment of a new sales office at 30 N. LaSalle Street, Chicago, Ill. Heading all sales activities from this office will be B. E. Engstrom, Midwest Sales Manager.

Other changes in sales positions announced were:

Mr. B. F. Marcin, Sales Engineer, has been transferred from the New York City area to new and greater responsibilities in Pittsburgh.

Mr. Lewis M. Poag has been appointed to handle sales of metal products including hydrants and valves in the Cincinnati area. Mr. Poag will be located at 3642 Bellecrest Avenue.

Mr. Frank C. Zeis, formerly of the Missouri Construction & Machinery Company, has joined the Company to handle sales in the St. Louis area. Mr. Zeis is located at 1432 Lanvale Drive, Webster Groves, Missouri.

Mr. Leon A. Hoffmeister, a sales engineer for the company for more than 15 years, has been transferred to the firm's New York offices at 500 Fifth Ave.

Sennet to Represent National Water Main Cleaning

Lowell E. Sennet, Chicago District Sales Engineer of The A. P. Smith Manufacturing Company, East Orange, New Jersey, will also represent the National Water Main Cleaning Company, 50 Church Street, New York City, New York.

Mr. Sennet's sales territory consists of the states of Illinois, Indiana, Wisconsin and Michigan.

The Smith Company Sales Office is at 8 South Dearborn Street, Chicago 3, Illinois. The National Water Main Cleaning Company Sales Office is at 122 South Michigan Avenue, Chicago 3, Illinois.

R. P. Nick Appointed Gen. Mgr. of Pleuger Pumps

Pleuger Submersible Pumps, Inc., Lancaster, Pa., has announced the appointment of Robert P. Nick as General Manager.

Mr. Nick was formerly a partner in the Lancaster Electronic Laboratory and Vice-President of Fidelity Electric and the Everite Pump Co. In addition to his new duties as General Manager of Pleuger, he will retain his position as Vice-President and member of the Board of Directors of the Fidelity Instrument Co., in York, Pa.

Conoflow Appoints Two New Representatives

Conoflow Corporation, Philadelphia, Pa., has announced the appointment of two new sales-engineering representatives for Cono Controls.

The Williams Equipment Company, New Orleans, Louisiana, will service southeastern Louisiana and southern Mississippi. Mr. R. L. Williams, principal of the organization, is well known in this area, having been affiliated with the Minneapolis-Honeywell Regulator Company in the capacity of Industrial Branch Manager of their New Orleans office for a number of years. Mr. Williams is an engineering graduate of the University of Texas, carries registered professional engineer's papers and is a member of the Baton Rouge Section of the Instruments Society of America.

Engineered Instrument Sales Company with offices in Memphis, Tennessee, will cover the western part of Tennessee, the northern half of Mississippi and the eastern portion of Arkansas. James L. Shilane, President of the company, possesses extensive experience in the fields of instrumentation and automatic control. He has served as Executive Application and Sales Engineer for Foote Pierson & Company, Newark, N. J.; Chief Instrument Engineer of the H. K. Ferguson Company, New York, N. Y.; and more recently as Head of the Instrument Design Division, Vitro Corporation of America, New York, N. Y. Mr. Shilane holds Bachelor of Science Degrees in Chemical and Electrical Engineering from West Virginia University. He is a member of the Instrument Society of America.

Coghill Joins Carborundum Sales Staff

The Refractories Division of The Carborundum Company, Perth Amboy, N. J., has announced that Mr. H. T. Coghill has joined its sales staff and is now working in the Cincinnati territory, an area with which he is well acquainted, having been born and raised in Dayton, Ohio.

Mr. Coghill attended Antioch College and the University of Michigan, majoring in mechanical and chemical engineering. After concluding his formal education, he joined the technical staff of the American Cyanamid Company where he stayed 12 years. He then went to Ampco Metals as Manager of their Chicago district. After six years, however, he formed his own company, operating as a manufacturers agent—serving the metallurgical and process industries.

Today's Facts on Modern **SEWAGE EJECTION**

Blackburn-Smith Mfg. Co.
51 Garden Street, Hoboken, N. J.

I want to know how I can get better sewage ejection at lower cost.

Name.....

Company.....

Address.....

Features of BLACKBURN-SMITH EJECTORS

Switches operated automatically by float and electrical controls.
Snap-action valve controlled automatically, pneumatically and by float. Electrode controls.
Compact . . . motor compressor assembly and controls in "one package" unit.
Steel construction. Welded steel pots.
Simple piping for air, water.
No clogging screens, impellers, shredders.
No messy pump cleaning. Sanitary.
Unfailing, dependable operation.

BULLETIN S-50

for look-ahead municipal engineers

Get the facts you want on how to eliminate costly, complex piping for air and water, messy, unsanitary screens, impellers, shredders, expensive pump cleaning . . . in short, the facts on simple, dependable, economical, clean Blackburn-Smith Ejectors. Valves and switches are controlled automatically for unfailing operation by electricity, by floats, and by pneumatic action. Learn how simple, compact, and inexpensive they are to install, operate, and maintain compared to complicated systems. *Get today's facts today—Send the coupon in now!*

BLACKBURN-SMITH MFG. CO., INC.
51 GARDEN ST., HOBOKEN, N. J.
HO 3-4425 • N. Y. Tel., BA 7-0600

DAM REBUILT WITH "GUNITE"

This is Lower Doughty Pond Dam belonging to the Atlantic City, New Jersey, Water Department, a poured concrete structure with fresh water upstream and tide water at the downstream toe. This structure became seriously disintegrated and eroded as shown in the upper photo, and was completely restored with "GUNITE" a minimum of six inches in thickness with double mesh reinforcement.

The lower view shows the finished job completed by us in 1941. Both the upstream and downstream faces were restored with "GUNITE", as well as the wing walls.

Our 72-page general bulletin C-3000 describes this and scores of other uses of "GUNITE". We shall be glad to send it to you upon request.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES – ALLENTOWN, PA., U. S. A.
MANUFACTURERS OF THE CEMENT GUN

More Popular Every Day...

Leopold

Glazed Fire Clay

Tile Filter Bottoms

During 1954 more Leopold duplex filter bottoms were sold than in any previous year in our history. To date, there are well over 300 plants (with a daily capacity in excess of 1½ billion gallons) that have selected Leopold bottoms—including such major municipal installations as Phoenix, Arizona; Houston, Texas; Trenton, New Jersey; Detroit, Michigan; Baltimore, Maryland; Columbus, Ohio; Kansas City, Missouri; Omaha Nebraska; and Philadelphia, Pennsylvania. Represented in this group are the five largest municipal filter plants under construction in the country at this time.

There are, of course, good reasons why the Leopold Glazed Tile Filter Bottom is getting more popular every day. In this design, laterals and distributing blocks are combined in one permanent unit that insures equal distribution and uniform filtration. The individual blocks are made of de-aired fire clay, vitrified and salt glazed. They resist corrosion, are not subject to tuberculation, won't absorb any detrimental amount of water, are impervious to acids and alkalis, and will last indefinitely.

If you're looking for a practical, economical solution to your underdrain problems, consider the advantages offered by Leopold. We'll be glad to supply details—without obligation.

Look to Leopold for complete water purification and sewage plant equipment...

• Dry Chemical Feeders • Mixing Equipment
• Filter Operating Tables • Filter Bottoms

Write today for details

F. B. Leopold Co., Inc.
2413 W. Carson Street
Pittsburgh 4, Pa.

Chapman Valve Elects Officers

The Chapman Valve Manufacturing Company, Indian Orchard, Mass., has announced the following elections and appointments at a recent meeting of the Board of Directors:

Emerson G. Gaylord—re-elected Chairman of the Board; Ernest Cochran—re-elected President of the Company; David M. McIntosh was elected Executive Vice-President and was re-appointed Vice-President in Charge of Production; Joseph A. Cerow was re-appointed Vice-President in Charge of Engineering; Frank A. Hunter was appointed Vice-President in Charge of Sales; and A. Neilson Cochran was re-appointed Assistant Treasurer and Assistant Clerk.

Coho Named President of Pleuger Pumps

Pleuger Submersible Pumps, Inc., Lancaster, Pa., has announced that Mr. Ralph W. Coho, Jr., was named president of the company.

Friedrich W. Pleuger of Germany will remain as Chairman of the Board of Directors. Other officers and directors include: Henry F. Huth, Vice-President; George B. Hetrick, Treasurer; Robert L. Harner, Secretary; James P. Coho, R. E. Huber and Paul H. Trout.

Penn Industrial Instrument Becomes Div. of Burgess-Manning

Penn Industrial Instrument Corporation, Philadelphia, Pa., by corporate merger has become a division of Burgess-Manning Company of Libertyville, Illinois, and Dallas, Texas.

Penn instruments will continue to be manufactured at the Penn plant, 4110 Haverford Ave., Philadelphia. William C. Bennett, formerly President of Penn, has been elected Vice-President and Director of Burgess-Manning and will manage the new Division. William Melas, formerly Vice-President of Penn, was elected a Director of Burgess-Manning and will continue in charge of engineering and development. George D. Keller continues to be in charge of sales and will be assisted by William Braun who has recently joined the company. L. S. Kurtzhalz, formerly Secretary of Penn, has been elected Assistant Secretary of Burgess-Manning.

IN EVERY WAY A SOUND CHOICE...

Specify IOWA for...

Gate Valves
Tapping Sleeves and Valves
Check Valves
Indicator Post Valves
Square Bottom Valves
Hydraulic Valves
Motor Operated
Shear Gates
Fire Hydrants
Mud Valves
Flap Valves
Sluice Gates
Floor Stands
Valve Accessories

SINCE IOWA 1909

We manufacture complete equipment for water and sewage flow control in Filtration Plants, Sewage Disposal Plants and Pumping Stations. Specify Iowa and let us solve your problems.

IOWA VALVE COMPANY
OSKALOOSA, IOWA
A subsidiary of James B. Clow & Sons

Literature & Catalogs

Sewage Ejector Tables

428

Chicago Pump Company, Chicago, Illinois, has released a selection of **Engineering Tables** designed to simplify the selection of clog-proof "Flush Kleen" sewage ejectors.

Examples are given for determining the inflow, discharge heads and type of "Flush Kleen" sewage ejector to use in any of the following applications: underground municipal lift stations, industrial applications, building installations such as hotels, apartment buildings, bus terminals, railroad stations, etc.

Laboratory Equipment

429

Metalab Equipment Corp., Hicksville, N. Y., has just released a brochure on **Immediate Delivery on Sectional Laboratory Furniture.**

The brochure describes the facilities and the reasons why Metalab can make immediate delivery of laboratory equipment and how strict quality control methods are used in the manufacture of the equipment.

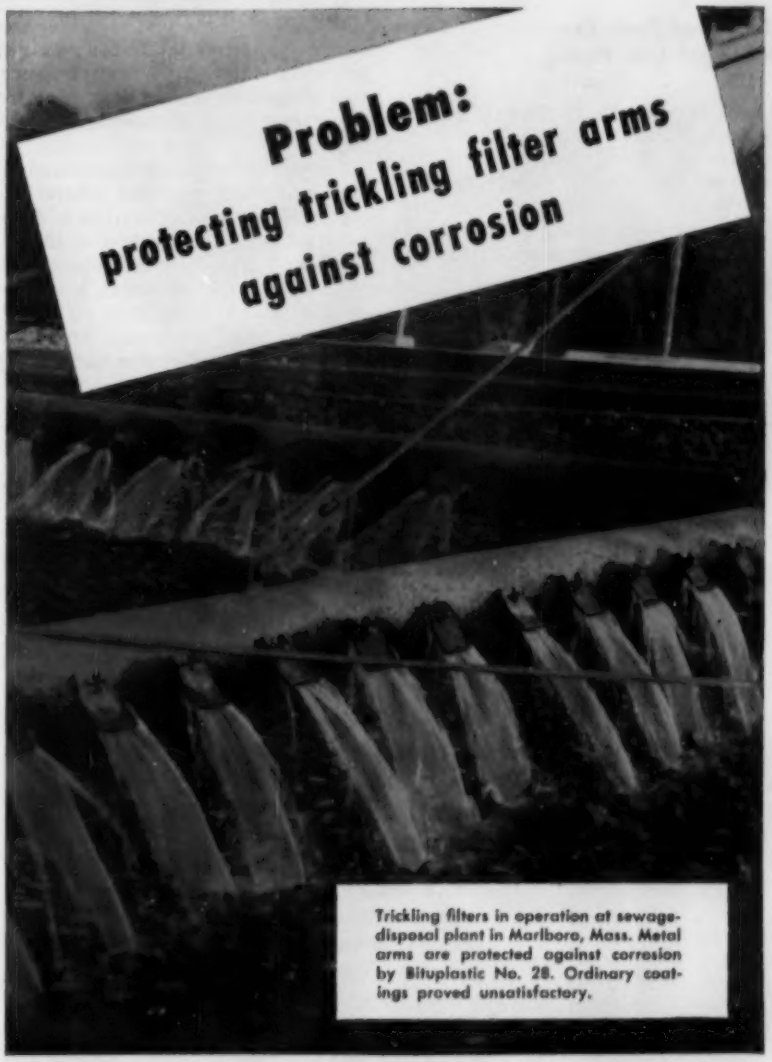
Convenient room layouts for laboratories are shown, and various items of equipment such as fume hoods, center and wall tables and combinations thereof, storage cabinets, service fixtures, and all types of accessories which complete the laboratory, are listed for the convenience of the reader. Complete specification information is listed on the back of this 12-page, 2-color brochure.

Stainless Steel Gate Valves

430

The Cooper Alloy Foundry Co., Hillside, N. J., has announced the availability of a catalog showing the major **Stainless Steel Gate Valves** in the Cooper Alloy line.

In addition to schematic drawings of the various valves the booklet includes a section on design factors, a discussion of construction materials, standards, and quality control measures. It also contains a table of major stainless alloys, giving their designations and applications.



Trickling filters in operation at sewage-disposal plant in Marlboro, Mass. Metal arms are protected against corrosion by Bituplastic No. 28. Ordinary coatings proved unsatisfactory.

• The Marlboro Sewage Department had an annoying problem. When conventional coatings were used, metal arms on trickling filters corroded quickly—so quickly that maintenance was a seemingly endless chore.

Then, a new method was tried. Metal surfaces were sand blasted, and given one coat of Bitumastic® Priming Solution, followed by two coats of Bituplastic® No. 28. Three years later the coating was inspected. In spots, there was slight evidence of chipping and cracking; but, in general, the coating was in excellent condition.

The Marlboro Sewage Department is well satisfied with the performance of Bituplastic No. 28 . . . no other coating has ever come close to this record.

Koppers makes a family of cold and hot-applied protective coatings, each specially formulated to control specific kinds of corrosion. Write for complete information on how these durable coatings can give your sewage plant long-lived protection against corrosion.

Protection for Water Lines

Koppers makes hot-applied Bitumastic® Enamels that protect interior and exterior surfaces of large-diameter water lines against every corrosive force found underground. Write for free literature.

MADE ONLY BY KOPPERS

BITUMASTIC® PROTECTIVE COATINGS

SOLD THROUGH INDUSTRIAL DISTRIBUTORS

KOPPERS®

KOPPERS COMPANY, INC.

Tar Products Division, Dept. 461-T, Pittsburgh 19, Pennsylvania

DISTRICT OFFICES: BOSTON, CHICAGO, LOS ANGELES, NEW YORK, PITTSBURGH, AND WOODWARD, ALA.

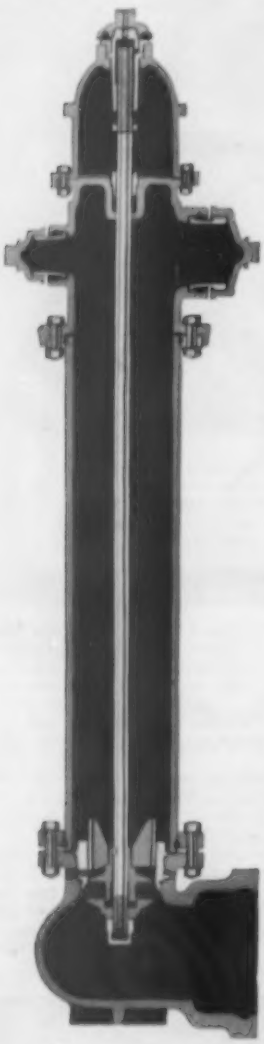
Technical Data On Wrought Iron Piping

431

A. M. Byers Company, Pittsburgh, Pa., has just published a Technical 1-page digest for architects, engineers, plant superintendents and others who specify **Wrought Iron Piping** in air conditioning lines, water supply and sanitary systems.

Listed in the reference piece under separate tables are size and dimensional data for both butt and lap weld pipe. Included in the tables are pipe sizes ranging from ¼-inch to 12-inches; outside and inside diameter, thickness; weight per square inch, mill test pressure, and weight in pounds-per-foot for plain ends and threads and couplings.

Other information contained in the data sheet includes a brief description of wrought iron's composition, an easy method of identification, a cross-section photograph of a sample of the metal, a review of the official standards to which wrought iron conforms, and supplementary information likely to be helpful to specifiers.



To meet every requirement

you can depend on

the MATHEWS Flange Barrel Hydrant

For maximum reliability at lowest cost, you can't buy better than the Mathews Flange Barrel Hydrant. It has all the features that you look for in a top-quality hydrant — internal parts removable through the barrel, compression-type valve to prevent leaking in case of damage, completely revolving head. In addition, every friction point is protected by at least one bronze surface, and all water-carrying areas are designed to reduce friction and loss of pressure.

And at slight extra cost...

The Breakable Flange and Stem Coupling—A specially designed flange in the standpipe just above ground level and a frangible coupling in the hydrant stem are both designed to snap when struck a blow heavy enough to break the hydrant. Both can be replaced quickly and inexpensively without excavation, while the rest of the hydrant remains undamaged.

MATHEWS HYDRANTS

Made by R. D. Wood Company
Public Ledger Building, Independence Square
Philadelphia 5, Pa.
Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

• Send for this 80-page catalog. It contains full information about the R. D. Wood line of Cast Iron Pipe, Fire Hydrants, Gate Valves, and Hydraulic Machinery.

Millipore Filter Membranes Report

432

The Millipore Filter Corp., Watertown, Mass., has just released a booklet containing a comprehensive summary of developments relative to the **MF Membrane.**

This illustrated booklet reviews approximately eighty technical articles reporting application of this new analytical screening device in the study of gaseous and liquid suspended particles in the submicron range in size.

Possibly the most interesting application of the MF filters, in the eyes of the bacteriologist, is their use in providing a porous matrix on which to grow microorganisms for study. Bacteria retained quantitatively on the very surface of this capillary structure may be kept well and evenly fed, and their growth carefully controlled, with only a few drops of culture medium.

The booklet states that results of analyses are available in a very much shorter period of time; for example, in the sanitary control of water, in sixteen hours as against forty-eight to ninety-six hours.

Bailey Recorder Specifications

433

Bailey Meter Company, Cleveland, Ohio, has just published a 12-page brochure on the new **Bailey Recorder,** a receiver recorder for pneumatic and electric transmission systems.

This profusely illustrated, 2-color brochure explains in detail the application, operation, engineering and ordering specifications of the new recorder.

Packaged Water Treatment Plant

434

Graver Water Conditioning Co., New York, N. Y., has just released a Technical Reprint which presents a comprehensive discussion of the **Graver Reactivator Packaged Water Treatment Plant.**

The reprint has a cut-away view of the plant showing the details of most of the equipment as well as a typical layout drawing. The heart of this plant is the Graver Reactivator, a high-rate, self-contained, softener and clarifier. There is a cross-sectional view of this unit with pictorial indications of flow and sludge movement.

Controlled Volume Pumps

435

Milton Roy Company, Philadelphia, Pa., has just released a bulletin describing and illustrating how **Controlled Volume Pumps** can be used as flow controllers, ratio controllers and final control elements in process instrumentation.

The first section of this pump handbook describes the various types of controlled volume pumps available, how they operate, and how stroke length and speed adjustment can be effected manually and automatically.

The second section contains approximately 20 different process flow diagrams describing typical applications in various industries. An engineering data section contains valuable information on how fluid characteristics and piping affect the operation of the pumps.

Cooling System Water

436

Hall Laboratories, Inc., Pittsburgh, Pa., has just released a 6-page folder entitled **"Cooling Water,"** which outlines the dangers of scale and corrosion in cooling systems and organic contamination of cooling system water.

The folder points out that failures in cooling systems, and resultant shut-downs for repair, can make production costs soar. Managing a cooling system to keep it efficient and economical usually is not a simple job, it is noted.

Also included in the folder are discussions of solutions found to cooling water problems in an oil refinery, a steel plant, and other industries.

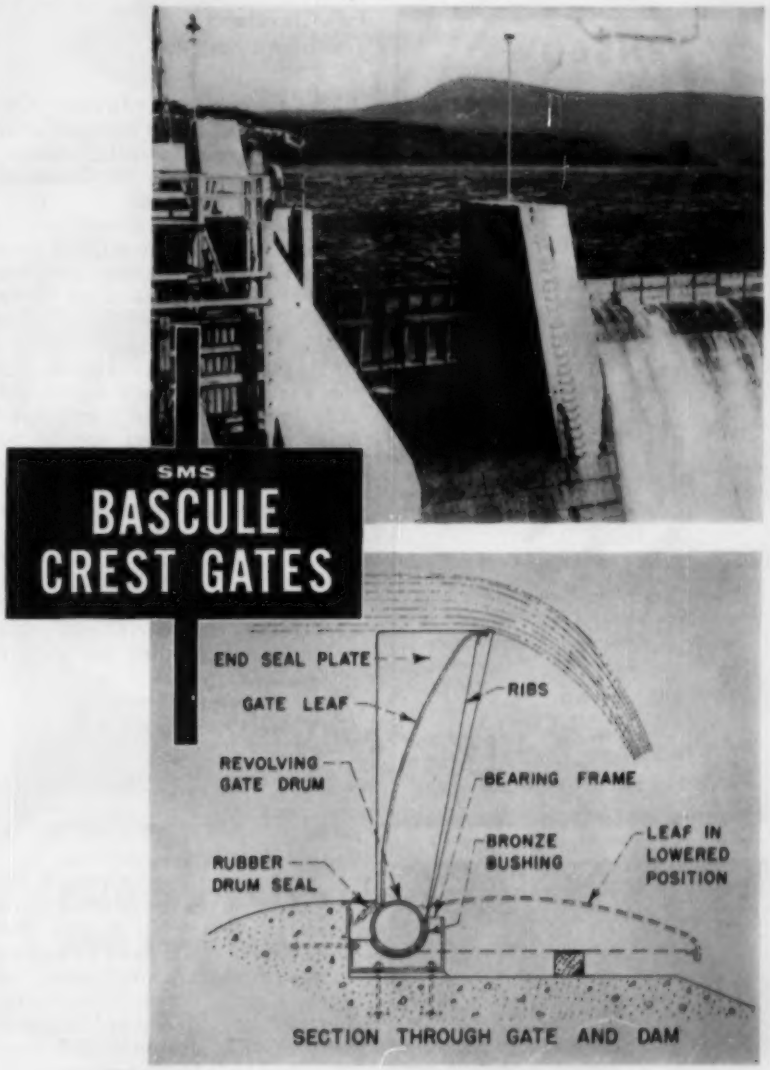
Filter Cloth Selection Chart

437

Filtration Fabrics Division, Filtration Engineers, Inc., Newark, N. J., has just released a 6-page, 2-color folder on **Feon Synthetic Filter Cloth.**

The folder contains all available engineering data to help in the selection of the right filter cloth for any application in filtration or dust collection.

Feon Dynel, Nylon, Orlon, Polyethylene, Saran and other materials are covered. Of particular interest are charts of chemical and temperature resistance, discussion of technical considerations, magnified views of the various weaves available, and performance case histories.



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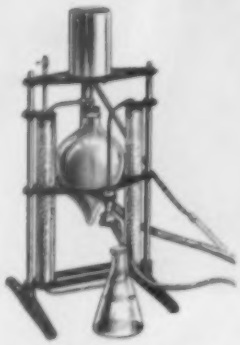

For checking the equilibrium of a finished water, and supplying an index useful in controlling anti-corrosion treatment. Catalog No. 83-895

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Full Cleveland Trencher Line

438

The Cleveland Trencher Co., Cleveland, Ohio, has just published a 4-page, 2-color bulletin describing the entire line of **Cleveland Trenching Equipment.**

Material in the bulletin is arranged to facilitate a quick comparison of the capacities, specifications and dimensions of all Cleveland models. Twenty-four action photos featured on pages 2 and 3 graphically illustrate various job applications on which Clevelands have been successfully employed. Brief text points out special advantages inherent in Cleveland design and construction features.

Page 4 of the bulletin features Cleveland's backfilling machines, The Models 80 and 80W backfillers and the Model 190 pipeline backfiller. Brief specifications of Cleveland trailers for general equipment and materials hauling are also included on page 4.

Air Valve Catalog

439

The Multiplex Manufacturing Co., Berwick, Pa., has available a recently revised catalog on the **Crispin Air Valves.**

This 24-page, 2-color catalog profusely illustrated with photographs, covers: Slip Joints; Turbine Valves; Air and Vacuum Valves; Pressure Air Valves; and Sewer Valves. A complete description of the valves; specifications and shipping weights; and materials used in the construction of the valves is also given.

The last five pages in the catalog are devoted to a partial listing of users in the 48 States and throughout the world.

Corrosion Resistant Valves

440

Alloy Steel Products Company, Inc., Linden, New Jersey, has just published a new 8-page illustrated bulletin describing **Aloyco 20 Corrosion-Resistant Valves.**

The new bulletin incorporates recent field-test data on Aloyco 20 in various concentrations of sulfuric acid at different temperatures. It also includes a description, applications, and advantages of this well-balanced, austenitic alloy, together with engineering specifications and cross-sectional illustrations of thirty-nine Aloyco 20 valves and fittings.

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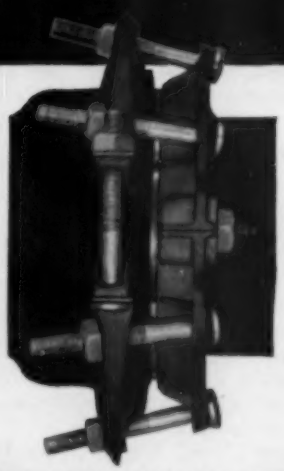

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Chemical Control and Testing of Water

441

Hall Laboratories, Inc., Pittsburgh, Pa., has just published a 6-page folder that discusses the need for intelligent **Chemical Control and Testing** to assure the success of a water conditioning program.

The folder points out that, unless the water treatment is well defined by explicitly stated control limits and unless chemical tests are used to show that these limits are being met, the treatment is likely to be either inadequate or wasteful.

Technical skill and experience are required to prescribe the proper control limits for plant operators, the new literature notes. But the job does not stop there.

The same technical skill is needed to choose appropriate testing methods and equipment, to instruct plant personnel in maintaining control limits at all times, and to check the continuing program, it is related.

The folder gives examples of the varying needs for testing equipment by different types and sizes of plants.

Cement Lining of Pipe Lines

442

Pipe Linings, Inc., Wilmington, California, has available a catalog on the **Cement Mortar Lining of Pipe Lines In Place.**

This attractive 12 page catalog gives a complete description of both the Tate process and the Centriline process and their advantages. Line drawings show the complete operation of both systems. Before and after photographs are shown as well as photographs of the machines in operation.

A table giving the before and after flow characteristics and a list of specifications complete the catalog.

General Municipal Supplies

443

W. S. Darley & Co., Chicago, Ill., has available a general catalog of **Municipal Supplies** handled by the company.

The 100-page catalog lists over 350 different items in the index that are of interest to municipalities, of which over 100 items are used by water and sewage plants. Photographs or drawings accompany most of the items along with complete descriptions and prices.

Other municipal supplies shown include traffic signals, police equipment, street equipment and fire equipment.

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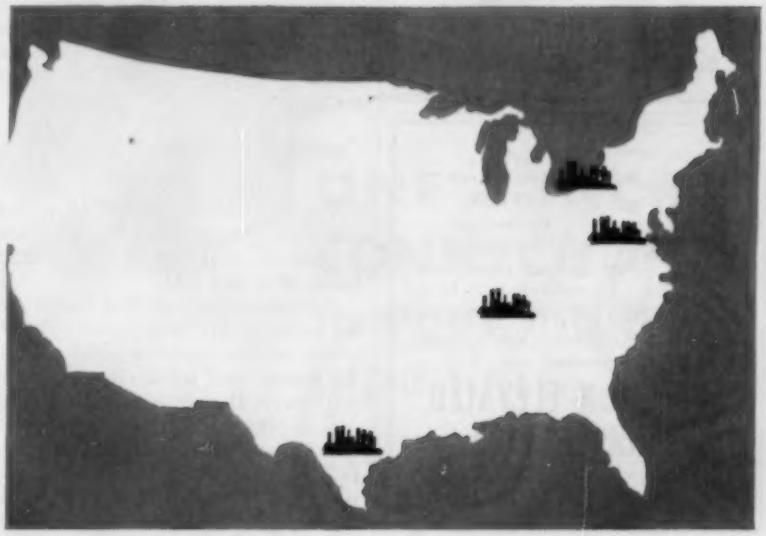

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Lubricated Plug Valves

444

ACF Industries, Incorporated, New York, N. Y., has just released a 42-page catalog on **ACF Lubricated Plug Valves.**

This catalog, profusely illustrated with photographs, line drawings and tables covers a variety of services for gasoline, water, oil, acids, caustic solutions and other fluids. Twenty-two of the principal services are mentioned on page three of the catalog. Also discussed is the new feature and added improvement in the valves which is the teflon gasket

Centrifugal Pumps

445

Pennsylvania Pump & Compressor Co., Easton, Pa., has available a bulletin on **Centrifugal Pumps Class MD and HD.**

A feature part of this bulletin is on page 2, where a number-keyed cross-section drawing points out all the names and numbers of the various parts that make up the pump.

Complete description and specifications are given for: casing; impeller; shaft; bearings; balancing port; stuffing boxes; coupling; casing and wearing rings; alignment; and standard equipment.

Power Operators for Throttling Control

446

Conoflow Corporation, Philadelphia, Pa., has published a 12-page booklet describing the **Cylinder Conomotor** — revolutionary pneumatically positioned power operator for throttling control service.

This bulletin illustrates the remarkable versatility of the Cylinder Conomotor and its many applications including proportional control of speed changers, valves, pumps and electrical components.

The Bernard Pressure Pilot Control for water supply systems is designed to operate pump motor controllers on single or multiple pump systems, according to the pressure demands, and to assure correct start and stop operation of pump motors without interference of water system surges. The Pilot Control also operates selective sequence control of pump motors according to the anticipated demand.

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Stainless Steel Valves

447

Cooper Alloy Foundry Co., Hillside, N. J., has just released a technical paper made up of **Seventy-Five Questions and Answers** designed to help in the selection and maintenance of stainless steel valves. The material for this paper was made up from the questions raised at the company's various valve clinics.

The article covers selection of materials, data on new materials, service and installation problems, as well as information on valve repair.

High Pressure Combination Cleaner

448

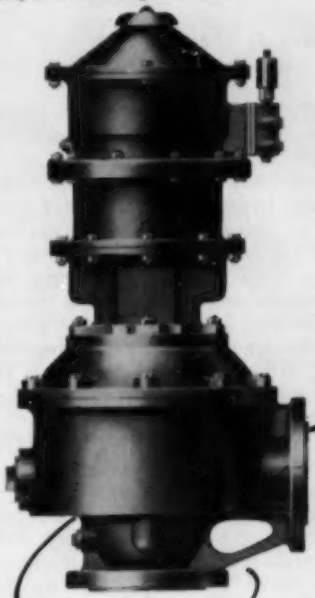
Malsbary Manufacturing Co., Oakland, Calif., has just published a bulletin on the new, improved Model 250 **High Pressure Combination Cleaner.** This 8-page catalog recommends uses, briefly describes the five different cleaning actions of the Model 250 and such exclusive patented features as the pumping system, and reverse blowdown for keeping coils free of scale. It shows the Malsbary full-swivel steam gun and heavy-duty diaphragm pump; tells how the new Model 250 provides greater volume (360 g.p.h.), greater pressure (to 300 p.s.i.), and higher temperatures (to 325°F.). It also contains a cost comparison chart, an easy-to-follow operating chart, and condensed specifications.

Uses for Sodium Phosphates

449

Monsanto Chemical Co., Inorganic Chemicals Division, St. Louis, Mo., has just published a booklet containing more than 50 sample formulations that demonstrate the uses of **Sodium Phosphates.**

In addition, complete specifications on 10 of the most widely used of these versatile phosphate salts are listed. Typical analysis, shipping classifications, packing, granulation and bulk densities are given. Also described are the general properties of the various salts for detergency, water softening, peptization, buffering compositions and sequestering agents.



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Feeding of Chemicals

450

Hall Laboratories, Inc., Pittsburgh, Pa., has just released a folder that states that hit-or-miss addition of chemicals can be just as harmful to an industrial water system as improper prescription of medicine is to the human body.

The new folder, **Feeding of Chemicals,** states that when chemical feeding systems are not properly designed for the problem at hand, difficulties leading to loss of time, production, and money can result.

Examples are given of tube failures, plugged feed lines, and other troubles caused by ill-advised chemical feeding on the part of inexperienced personnel. Many dollars and much grief could have been saved by simply calling on qualified specialists to help, states the folder.

Gratings and Stair Trends

451

Dravo Corporation, Pittsburgh, Pa., has just published a bulletin that describes the complete line of Tri-Lok Interlocked and Tri-Forges Welded **Grating and Stair Treads.**

The 16-page booklet explains important construction features of the two types. Photographs and detail sketches fully illustrate the many styles available as well as typical installations and applications. Information on serrated grating, armoring and flooring is also included in the bulletin.

A series of tables list the grating weights, standard sizes of safety stair treads, panel widths, and the safe bearing loads for various bearing-bar spacings. Diagrams explain typical fastening devices, and how they are applied to hold the grating panels secure. Complete specification information is included.

Short Body Fittings

452

Warren Foundry & Pipe Corporation, New York, N. Y., has just published an 8-page booklet entitled **Warren Short Body Fittings.**

The booklet provides the detailed standard specifications for short body pressure fittings and illustrates the design, dimensions and types of fittings available from the company's Everett, Mass., or Phillipsburg, New Jersey, plants.

Malleable Couplings

453

Gustin-Bacon Manufacturing Company, Kansas City, Mo., has just published a 16-page illustrated folder on **Malleable Pipe Couplings and Fittings.**

Thirty photographs demonstrate the savings in time and labor made by Rolagrip couplings for plain end pipe and Gruvagrip and Gruvajoint couplings for grooved pipe. Diagrams and complete specifications for these products, as well as Gruvagrip fittings, are included.

Pipe Connections, Unions, and Bleeder Valves

454

Gray Tool Company, Houston, Texas, has just published a new 12-page, 2-color, combination engineering manual and catalog that completely describes the new GRALOC line of **Universal Pipe Connections, Unions, and Bleeder Valves.**

Describing a new concept of all-steel sealing with a pressure-aided seat termed by the manufacturer as the GRALOC principle, the book shows how this principle has been incorporated into a pipe connection and union covering connection ranges from ½" to 12" and vent-drain-bleeder.

Complete descriptions are given of applications which simplify and improve piping systems, as well as results of independent laboratory tests proving the pipe connection to be leakproof for any internal or external condition the pipe is capable of withstanding, from a full vacuum to the highest super-pressure applications. In addition the book gives complete data on construction, operation, advantages, specifications, dimensions, pressure ratings and prices.

Mechanical Separator

455

Chain Belt Company, Milwaukee, Wis., has just released a bulletin on the **Rex Float-Treat.** Float-Treat is a trade name assigned to a new mechanical process used to separate greases, chemical flocs, and suspended organic matter from industrial waste liquids.

The new booklet describes the Float-Treat system in detail through the use of plan views, diagrams, photos and text.

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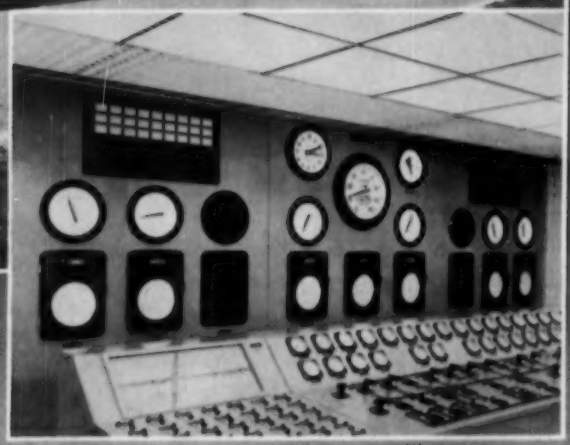

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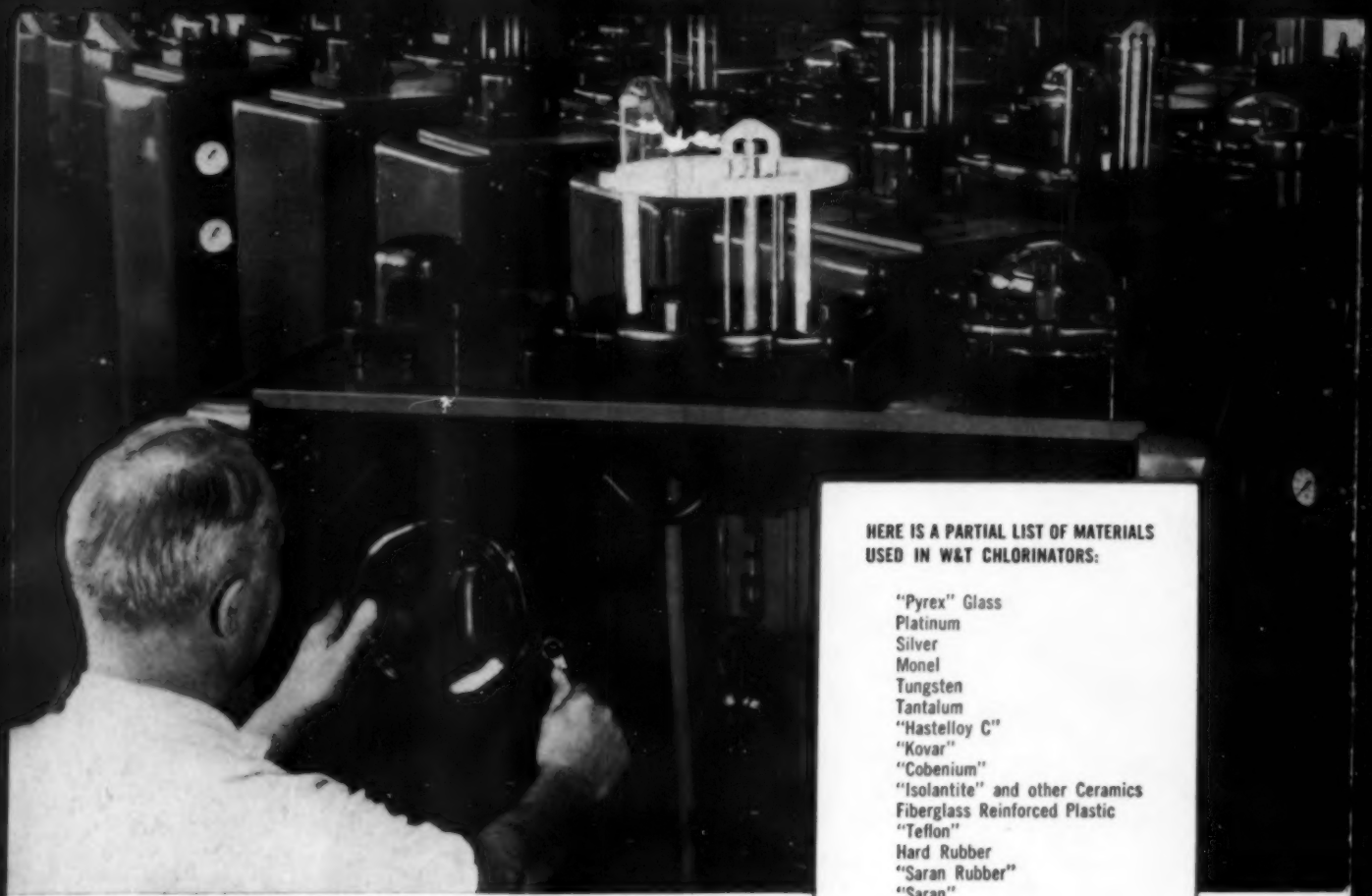

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